



PROJECT AIR FORCE

CHILDREN AND FAMILIES
EDUCATION AND THE ARTS
ENERGY AND ENVIRONMENT
HEALTH AND HEALTH CARE
INFRASTRUCTURE AND
TRANSPORTATION
INTERNATIONAL AFFAIRS
LAW AND BUSINESS
NATIONAL SECURITY
POPULATION AND AGING
PUBLIC SAFETY
SCIENCE AND TECHNOLOGY
TERRORISM AND
HOMELAND SECURITY

The RAND Corporation is a nonprofit institution that helps improve policy and decisionmaking through research and analysis.

This electronic document was made available from www.rand.org as a public service of the RAND Corporation.

Skip all front matter: [Jump to Page 1](#) ▼

Support RAND

[Purchase this document](#)

[Browse Reports & Bookstore](#)

[Make a charitable contribution](#)

For More Information

Visit RAND at www.rand.org

Explore [RAND Project AIR FORCE](#)

View [document details](#)

Limited Electronic Distribution Rights

This document and trademark(s) contained herein are protected by law as indicated in a notice appearing later in this work. This electronic representation of RAND intellectual property is provided for non-commercial use only. Unauthorized posting of RAND electronic documents to a non-RAND website is prohibited. RAND electronic documents are protected under copyright law. Permission is required from RAND to reproduce, or reuse in another form, any of our research documents for commercial use. For information on reprint and linking permissions, please see [RAND Permissions](#).

Report Documentation Page				Form Approved OMB No. 0704-0188	
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE 2012		2. REPORT TYPE		3. DATES COVERED 00-00-2012 to 00-00-2012	
4. TITLE AND SUBTITLE The Air Force's Experience with Should-Cost Reviews and Options for Enhancing Its Capability to Conduct Them				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) RAND Corporation, Project Air Force, 1776 Main Street, P.O. Box 2138, Santa Monica, CA, 90407-2138				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT Same as Report (SAR)	18. NUMBER OF PAGES 65	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

This product is part of the RAND Corporation technical report series. Reports may include research findings on a specific topic that is limited in scope; present discussions of the methodology employed in research; provide literature reviews, survey instruments, modeling exercises, guidelines for practitioners and research professionals, and supporting documentation; or deliver preliminary findings. All RAND reports undergo rigorous peer review to ensure that they meet high standards for research quality and objectivity.

R E P O R T

The Air Force's Experience with Should-Cost Reviews and Options for Enhancing Its Capability to Conduct Them

Michael Boito, Kevin Brancato, John C. Graser,
Cynthia R. Cook

Prepared for the United States Air Force

Approved for public release; distribution unlimited



PROJECT AIR FORCE

The research described in this report was sponsored by the United States Air Force under Contract FA7014-06-C-0001. Further information may be obtained from the Strategic Planning Division, Directorate of Plans, Hq USAF.

Library of Congress Cataloging-in-Publication Data

The Air Force's experience with should-cost reviews and options for enhancing its capability to conduct them / Michael Boito ... [et al.].

p. cm.

Includes bibliographical references.

ISBN 978-0-8330-6027-3 (pbk. : alk. paper)

1. United States. Air Force—Procurement—Cost control. 2. United States. Air Force—Weapons systems—Costs. 3. Defense industries—Estimates—United States. 4. Defense contracts—Prices—United States. 5. Defense contracts—United States—Evaluation. I. Boito, Michael, 1957-

UG1123.A34 2012

358.4'18—dc23

2012020062

The RAND Corporation is a nonprofit institution that helps improve policy and decisionmaking through research and analysis. RAND's publications do not necessarily reflect the opinions of its research clients and sponsors.

RAND® is a registered trademark.

© Copyright 2012 RAND Corporation

Permission is given to duplicate this document for personal use only, as long as it is unaltered and complete. Copies may not be duplicated for commercial purposes. Unauthorized posting of RAND documents to a non-RAND website is prohibited. RAND documents are protected under copyright law. For information on reprint and linking permissions, please visit the RAND permissions page (<http://www.rand.org/publications/permissions.html>).

Published 2012 by the RAND Corporation

1776 Main Street, P.O. Box 2138, Santa Monica, CA 90407-2138

1200 South Hayes Street, Arlington, VA 22202-5050

4570 Fifth Avenue, Suite 600, Pittsburgh, PA 15213-2665

RAND URL: <http://www.rand.org>

To order RAND documents or to obtain additional information, contact

Distribution Services: Telephone: (310) 451-7002;

Fax: (310) 451-6915; Email: order@rand.org

Preface

In the spring of 2009, the Deputy Assistant Secretary for Acquisition Integration, Office of the Assistant Secretary of the Air Force for Acquisition, and the Deputy Assistant Secretary for Contracting, Office of the Assistant Secretary of the Air Force for Acquisition, asked RAND Project AIR FORCE to assist the Air Force in enhancing its contract cost/price analysis capability in order to improve the outcomes of its major weapon system development contract negotiations.

Midway through the study, the sponsors expanded its scope to include the feasibility of improving cost realism assessments for development contracts and developing a capability for should-cost reviews. Federal Acquisition Regulation (FAR) 15.407 defines the *should-cost review* as a specialized form of contract cost analysis that seeks to improve contractor efficiency and lower contract cost to the government.

In September 2010, after the research for this study was completed earlier in that year, the Under Secretary of Defense for Acquisition, Technology, and Logistics (USD[AT&L]) issued guidance to the Department of Defense (DoD) that mandates the use of should-cost analysis for major programs (Carter, 2010a). In November 2010, USD(AT&L) issued an implementation memorandum for the September 2010 guidance that directed DoD components to establish should-cost targets for Acquisition Category I, II, and III programs as they are considered for acquisition milestone decisions (Carter, 2010b). USD(AT&L) provided further clarification in an April 2011 memorandum (Carter and Hale, 2011) that explained that should-cost estimates can be developed in three ways: (1) conducting a detailed, bottom-up analysis, (2) identifying discrete reductions from will-cost estimates, and (3) using competitive contracting and contract negotiations.

Because of the widespread interest throughout DoD in should-cost reviews after the issuance of the USD(AT&L) memos, RAND extracted and expanded the research on should-cost reviews from the larger study into this separate technical report. The RAND research addressed should-cost reviews as described in the FAR and similar analyses, although many of the historical examples did not fully meet the FAR description. The historical experiences reviewed in this report encompass the first two approaches found in the April 2011 guidance. This publication focuses on RAND's investigation of previous should-cost reviews, which addressed two key questions:

- What has been the Air Force experience with should-cost reviews?
- How can the Air Force enhance its capability to conduct should-cost reviews?

This report should interest those involved in acquiring defense goods and services at the most favorable prices, particularly acquisition personnel who may be involved in planning or conducting should-cost reviews, including program managers, contracting personnel, cost

estimators, industrial engineers, and subject-matter experts in the technologies used in major weapon systems.

This research was conducted within the Resource Management Program of RAND Project AIR FORCE as part of the fiscal year 2009–2010 study “Enhancing the Price Analysis Capability of the U.S. Air Force for Development Contracts.”

RAND Project AIR FORCE

RAND Project AIR FORCE (PAF), a division of the RAND Corporation, is the U.S. Air Force's federally funded research and development center for studies and analyses. PAF provides the Air Force with independent analyses of policy alternatives affecting the development, employment, combat readiness, and support of current and future air, space, and cyber forces. Research is conducted in four programs: Force Modernization and Employment; Manpower, Personnel, and Training; Resource Management; and Strategy and Doctrine.

Additional information about PAF is available on our website:
<http://www.rand.org/paf>

Contents

Preface	iii
Table	vii
Summary	ix
Acknowledgments	xiii
Abbreviations	xv
Glossary	xvii

CHAPTER ONE

Introduction	1
Background	1
Purpose	2
Research Approach	3
Interviews	3
Literature	3
How the Report Is Organized	4

CHAPTER TWO

Background on Contract Pricing and Negotiation in the Department of Defense	
Acquisition Environment	5
Background on Should-Cost Reviews from the Federal Acquisition Regulation	7
What Is a Should-Cost Review?	7
When to Conduct a Should-Cost Review	8
Should-Cost Review Analytical Methods	8
Should-Cost Team Composition	8
Should-Cost Reports	9
Latest Guidance on Should-Cost Reviews Supplemental to the Federal Acquisition Regulation	9

CHAPTER THREE

What Has Been the Air Force Experience with Should-Cost Reviews?	11
Sources of Information on Air Force Experience with Should-Cost Reviews	11
Literature Review Results of Air Force Experience with Should-Cost Reviews	12
Historical Context	12
Do Should-Cost Reviews Save Money?	13
What Is the Composition of Should-Cost Teams?	14
What Was the Organizational Support and Process for Conducting Reviews?	15
Interview Results of Air Force Experience with Should-Cost Reviews	16

1980s: B-2.....	16
1990s: F-22	17
1990s: C-17	17
1990s: T-6 Joint Primary Aircraft Training System	18
2000s: Global Hawk, Evolved Expendable Launch Vehicle, and Global Hawk Again	18
Recent Should-Cost Experience of Other DoD Organizations with Air Force Programs.....	20
Summary of Experiences	21
Results.....	21
Team Composition and Methodology	21
Organizational Support	21

CHAPTER FOUR

The Use of Should-Cost Analysis and Similar Techniques in Commercial Businesses.....	23
Differences in Buying Environments Between DoD and Commercial Business.....	23
Clarification of Terms Found in Commercial Literature.....	24
The Nature of the Relationship with Suppliers and the Appropriate Method of Cost Analysis.....	25
Organizing for More Effective Cost Analysis and Buying in Supply Chain Management	26
Examples of the Use and Purposes of Should-Cost and Similar Techniques	27
Key Takeaways from Commercial Experience with Should-Cost and Similar Analysis	28
The Appropriate Nature of the Buying Relationship Between DoD and Its Suppliers.....	28
The Purposes for Which Should-Cost and Similar Analyses Can Be Used	28
How to Organize and Staff to Use Should-Cost and Similar Analyses Effectively	29

CHAPTER FIVE

How Can the Air Force Enhance Its Capability to Conduct Should-Cost Reviews?.....	31
Existing Should-Cost Review Capabilities.....	31
Key Workforce Capabilities Required for Should-Cost Reviews.....	32
Total Number of People Required to Conduct Should-Cost Reviews	33
Organization for a Should-Cost Review Capability	34

CHAPTER SIX

Recommendations and Conclusions	37
Recommendations	38
Determine Whether Should-Cost Reviews in the Air Force Result in Savings Compared with Other Forms of Contract Negotiation	38
Assess Lessons Learned from Recent Should-Cost Reviews.....	39
Develop Training on Should-Cost Reviews	39
Establish Databases of Cost, Schedule, Earned Value, and Technical Information Useful for Cost Estimating and Pricing Activities.....	40
Conclusions	41
References	43

Table

5.1. Advantages and Disadvantages of Organizational Options for an Air Force
Should-Cost Capability 36

Summary

The Air Force, along with the other military services, has been plagued with a history of cost overruns in major acquisition programs, such as the C-5A and C-17A cargo aircraft and F-22A and F-35 fighter aircraft programs. A series of studies has shown that part of that growth can be attributed to poor initial cost estimates.¹ Additionally, there has been a long-standing concern since the 1990s about the size, experience level, and quality of the acquisition workforce. These concerns, along with the opportunity for the Air Force to increase the size of its acquisition workforce as part of a larger Department of Defense (DoD)–wide initiative,² prompted the Air Force to ask RAND Project AIR FORCE to help it find ways to improve its contract cost/price analysis capability. The Air Force sponsors of this research were particularly interested in the feasibility of improving the Air Force’s capability to conduct should-cost reviews, which are defined by Federal Acquisition Regulation (FAR) 15.407 as a special form of contract cost analysis.³ This report responds to the sponsors’ questions about should-cost reviews.

The primary methodologies used to address the questions were (1) interviews conducted with participants in should-cost reviews of Air Force programs and (2) reviews of the literature on should-cost analyses in DoD and in commercial organizations.

Findings

The research team posed the following two questions regarding should-cost reviews:

- What has been the Air Force experience with should-cost reviews?
- How can the Air Force enhance its capability to conduct should-cost reviews?

What Has Been the Air Force Experience with Should-Cost Reviews?

The Air Force has conducted should-cost reviews or similar analyses since the 1960s, but they have been done infrequently and with mixed results. They have been performed during the development, procurement, and sustainment phases of major programs, ranging in scope from

¹ Various individuals and organizations have studied the sources of cost growth in military acquisition programs. Recent RAND research on the subject includes Bolten et al. (2008) and Blickstein et al. (2011).

² Due to budget pressures and reductions in end strength, the Air Force has been unable to increase its acquisition workforce above the level it was at the end of fiscal year 2008.

³ “[T]hese reviews evaluate the economy and efficiency of the contractor’s existing work force, methods, materials, equipment, real property, operating systems, and management. . . . The objective of should-cost reviews is to promote both short and long-range improvements in the contractor’s economy and efficiency in order to reduce the cost of performance of Government contracts” (FAR 15.407-4).

reviews of the entire program to smaller modification efforts. The reviews require a mix of people with such skills as cost estimating, pricing, and contracting and subject-matter expertise in manufacturing or other areas relevant to the particular program being reviewed. Some argue that industrial engineers are also important members of any review team.

The size and composition of the teams and the duration of should-cost reviews vary with the scope of the review and nature of the program. For major reviews in the past two years, industrial engineers and price analysts and other contracting personnel have been less represented than in earlier Air Force experience. It is not clear whether the skill mix required has changed or whether individuals with these skills were needed but not available.

Finding people within DoD who have the requisite skills to do should-cost reviews on a temporary basis poses challenges and diverts the individuals from their primary tasks. The reviews are typically done infrequently on major acquisition programs.

There is limited and mixed evidence as to whether should-cost reviews save money compared with other forms of contract negotiation. Ideal comparisons to answer this question would be of final contract prices on matched pairs of contracts (same contractor, weapon system, and contract type), where one contract is negotiated using data from a should-cost review and the other contract is negotiated in some other way.

Potential savings identified during reviews may not necessarily be realized in contract negotiations or achieved in the final price to the government. Prominent practitioners of should-cost reviews of DoD programs say they can identify inefficiencies and potential savings during their analyses, but this does not necessarily lead to savings to the taxpayer. The procuring organization must have the ability and willingness to use the results of the analysis in contract negotiations to achieve a lower contract price. And the procuring organization must further structure and administer the contract in such a way that cost growth and contract modifications do not negate the originally negotiated contract price.

As of the time of the writing of this report in fall 2011, the Air Force has no dedicated capability to conduct should-cost reviews. The Air Force instead finds the required individual skills from across the Air Force and among Air Force retirees, federally funded research and development centers, support contractors, and other government agencies.

The ad hoc and infrequent nature of the reviews, combined with the absence of a dedicated capability to conduct them in the Air Force, has resulted in an acquisition workforce in which few people have experience with the reviews, and there is no core group that can learn from experience, retain lessons learned, and lead or provide training to inexperienced staff.

How Can the Air Force Enhance Its Capability to Conduct Should-Cost Reviews?

The Air Force needs to be able to match the demand for should-cost reviews with a supply of people with the appropriate skills and experience to conduct them. There are limited numbers of personnel in some fields that have traditionally been involved in should-cost reviews, including cost estimating, pricing, and industrial engineering. In addition, few people in the Air Force have experience with conducting these reviews.

A skeletal or virtual should-cost review office, with the capability to provide ad hoc training to team members, collect and retain lessons learned, and quickly obtain personnel with critical skills, would enhance the Air Force's capability to conduct these reviews. There are also other, more robust (but more costly) options for organizational support of the capability, such as an office staffed with a core cadre of experts to lead reviews and train other members or an office with a large, dedicated staff capable of conducting a review of a major program.

Recommendations

We suggest four recommendations that should improve the Air Force's ability to conduct should-cost reviews.

Determine Whether Should-Cost Reviews Result in Savings Compared with Other Forms of Contract Negotiation

When inadequate competition exists to determine contract prices, the government determines a fair and reasonable price objective and attempts to reach agreement on the price with the contractor through negotiation. A fair and reasonable price can be determined in various ways. For relatively small and routine procurements, the pricing is usually done by the procuring contracting officer. For larger contracts over certain dollar thresholds,⁴ the pricing is usually done by pricers, usually with technical input from subject-matter experts. In certain cases, generally for large procurement programs, the pricing can be enhanced through a should-cost review that informs contract negotiations.

A detailed analysis of should-cost review outcomes was beyond the scope of this study. Information on contract negotiations and outcomes is retained by local contracting offices, generally in paper records, and is difficult for those outside the office to obtain. The RAND research team found little evidence in the published research to indicate that should-cost reviews have achieved better results than other methods of contract pricing and negotiation. An important first step in formulating a strategy for the use of should-cost reviews would be to determine whether they result in savings compared with other forms of contract negotiation, and under what circumstances. This determination would inform Air Force efforts to devote additional resources to a should-cost review capability. If historical reviews are found to produce results no better than other forms of contract pricing and negotiating, the Air Force should allocate resources accordingly. If reviews using a particular methodology are found to be especially successful, resources should be devoted to ensuring that people with the skills and training needed for the successful methodology are available.

Assess Lessons Learned from Recent Should-Cost Reviews

The lack of a dedicated capability within the Air Force to conduct should-cost reviews and the shortage of people within the Air Force with experience in conducting such reviews suggest a lack of broad and current institutional knowledge of the subject. The Air Force should conduct an assessment of lessons learned from should-cost reviews across DoD. The assessment should address the outcomes of the reviews, whether people with the required skills were available and what additional skills would be needed for similar reviews in the future, whether sufficient time was available for the reviews, and the role of training in the capability to conduct the reviews. The Air Force may also benefit from comparing its experience with should-cost against the practices used by the best commercial organizations.

⁴ A threshold of \$10 million at three of the Air Force product centers is specified in the Air Force Materiel Command Federal Acquisition Regulation Supplement.

Develop Training on Should-Cost Reviews

If should-cost reviews are found to be effective in lowering contract prices relative to other forms of negotiations, the Air Force should ensure that appropriate training is available for teams. Training should encompass several areas:

- how to assemble a team
- how to conduct a should-cost review
- how to work as a multidisciplinary team
- lessons learned from previous reviews, including the possible finding that new should-cost processes are needed to address the increased use of outsourcing.

Establish Databases of Cost, Schedule, Earned Value, and Technical Information Useful for Cost-Estimating and Pricing Activities

An industry best practice is to develop a database that can be used strategically for contract negotiations. In the Air Force, relevant data, such as those on cost, schedule, earned value, and technical issues, are collected by members of various disciplines but not necessarily shared. These data could be collected into databases and used to develop a better understanding of industry standards, improved cost-estimating relationships, and documentation of contractor performance.

Acknowledgments

The authors of this report held extensive discussions with many people in DoD and the defense industry who generously shared their time and insights. We promised them that their participation in the study would be kept on a not-for-attribution basis and therefore do not want to list the names of study participants. Nevertheless, we want to thank all those who shared their time and information with us. Our most extensive discussions were with pricers at all the Air Force's product and logistics centers and cost estimators at some product centers and other locations, and we are especially grateful to these acquisition professionals for sharing their thoughts and experiences.

Several DoD personnel reviewed a draft of this work and provided comments. We thank William Bartlebaugh of the Air Force Cost Analysis Agency; David Dudley of the Air Force Electronics System Center; Tommy Gilbert of Warner Robins Air Logistics Center; Daniel Hodge of Ogden Air Logistics Center; David Mabee of the Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics; Stephen Trautwein of the Defense Contract Management Agency; Eric Unger of the Air Force Institute of Technology; and Mark Wallentine of Warner Robins Air Logistics Center.

We thank Blaise Durante, Deputy Assistant Secretary for Contracting, Office of the Assistant Secretary of the Air Force for Acquisition, and Scott Correll, former Deputy Assistant Secretary for Contracting, Office of the Assistant Secretary of the Air Force for Acquisition, for sponsoring this study and providing guidance during it.

Among our RAND colleagues, Jerry Sollinger edited and helped restructure earlier drafts of the document. Hosay Salam provided administrative support. Nancy Moore, Mike Thirtle, and Laura Baldwin reviewed earlier drafts and provided useful suggestions to restructure the document. Lara Schmidt, Phyllis Gilmore, and James Torr reviewed and edited the document and provided comments, suggestions, and formatting changes that improved its quality.

Abbreviations

ACAT	acquisition category
ACO	administrative contracting officer
AFP	Air Force pamphlet
AFTOC	Air Force Total Ownership Cost database
CAIV	cost as an independent variable
CEO	chief executive officer
CPO	chief procurement officer
DAU	Defense Acquisition University
DCARC	Defense Cost and Resource Center
DCMA	Defense Contract Management Agency
DLA	Defense Logistics Agency
DoD	U.S. Department of Defense
EELV	Evolved Expendable Launch Vehicle
EMD	engineering and manufacturing development
FAR	Federal Acquisition Regulation
FPI	fixed-price incentive
FY	fiscal year
GAO	U.S. General Accounting Office (now U.S. Government Accountability Office)
JSF	Joint Strike Fighter
OSD	Office of the Secretary of Defense
PAF	RAND Project AIR FORCE
PGI	Procedures, Guidance, and Information
USD(AT&L)	Under Secretary of Defense for Acquisition, Technology, and Logistics

Glossary

administrative contracting officer	A contracting officer (see definition below) who administers contracts.
contracting officer	A person with the authority to enter into, administer, and/or terminate contracts and make related determinations and findings.
contracting personnel	Civilians in occupational series GS 1102 and military personnel with similar duties, including those who specialize in negotiating, administering, terminating, and analyzing the cost and price of contracts.
cost estimators	Analysts within the business-cost estimating career field, who use some techniques similar to those used by pricers in the contracting career field.
cost-reimbursement contract	Contract for which the government reimburses the contractor for all reasonable and allowable charges.
fixed-price contract	Contract for which the contractor assumes responsibility for performing work at an agreed-upon specified price.
pricers	Formally known as contract cost/price analysts, a subset of contracting personnel who specialize in analyzing the cost and price of contractor proposals to ensure that contracts are awarded at fair and reasonable prices.
will-cost estimate	Cost estimates informed by historical experience with similar systems.

Introduction

Background

This research on pricing capability was motivated by the long-standing problems of cost growth of major weapon system acquisition programs and the high costs in general of Department of Defense (DoD) equipment.¹ The problem of cost growth has plagued DoD for several decades. Many studies have documented the amount of the growth, and some have looked at the causes of the growth. Many of these studies have used data from Selected Acquisition Reports prepared by DoD and sent to Congress on major defense acquisition programs. The most recent RAND Corporation study of this type that measured the amount of the growth and analyzed the sources of growth examined 35 mature programs (Bolten et al., 2008). The study found an average cost growth of 57 percent in development and 34 percent in production (after adjusting for changes in quantity) (pp. 28–29). More recent RAND research has explored in more depth the root causes of cost growth in acquisition programs (Blickstein et al., 2011).

Concern over cost growth and the affordability of DoD programs prompted Office of the Secretary of Defense (OSD) leadership to issue management initiatives to increase efficiency and affordability in DoD acquisition in 2010. In September 2010, the Under Secretary of Defense for Acquisition, Technology, and Logistics (USD(AT&L)) issued guidance on 23 management initiatives to increase efficiency. One of the initiatives requires program managers of major acquisition programs to conduct should-cost reviews of their programs (Carter, 2010a). In November 2010, USD(AT&L) issued an implementation memorandum of the September 2010 guidance (Carter, 2010b). The latter memorandum directed DoD components to establish should-cost targets for Acquisition Category (ACAT) I, II, and III programs as they are considered for acquisition milestone decisions.² In April 2011, USD(AT&L) issued additional guidance on the implementation of will-cost and should-cost management (Carter and Hale, 2011), which described three methods that can be used to develop should-cost esti-

¹ The term *cost growth* in this context refers to the increase in cost of a given contract or program, which is generally measured from a cost estimate at the start of development to the completed cost of the program. Many studies of cost growth, including the RAND study referenced here, use data from Selected Acquisition Reports, which include the contractor's cost, fee, and some associated government costs. The growth in all these costs is what is measured, and this measure must be understood as a proxy for the growth experienced on any individual contract. Furthermore, this type of cost growth measure does not take into account modifications to contracts that reflect changes in the scope of work.

² ACAT I programs are major acquisition programs subject to OSD-level review; ACAT II programs have estimated total research, development, test, and evaluation (RDT&E) costs of more than \$140 million or total procurement costs of more than \$660 million in fiscal year (FY) 2000 constant dollars; ACAT III programs do not meet the threshold for ACAT II programs and can be designated by the Component Acquisition Executive.

mates.³ One way is a detailed, bottom-up analysis. A second way is by identifying discrete reductions from will-cost estimates. A third way is through the use of competitive contracting and contract negotiations.

The Air Force issued its own implementation guidance of the OSD initiative on will-cost and should-cost management in June 2011 (Morin and Van Buren, 2011). The Air Force guidance recognizes that the meaning of *should-cost review* addressed in the OSD and Air Force guidance is broader than the meaning used in the Federal Acquisition Regulation (FAR) (discussed in Chapter Two of this report). *Should-cost* as part of the management initiative encompasses both government and contractor costs throughout a program's life cycle. The Air Force guidance further clarifies that large, bottom-up analyses of programs are not required in every case and that program managers are expected to use their discretion in determining what kind of analysis is appropriate for their program.

The FAR defines and describes should-cost reviews as specialized forms of cost analysis used in support of contract negotiations. Should-cost reviews as defined by the FAR have been used for decades in DoD, and therefore there is more information available on how they have been conducted and the results they have achieved. In contrast, the OSD guidance issued in 2010 and 2011 and the Air Force guidance issued in 2011 describe the use of should-cost reviews as part of a broader initiative to manage programs and costs. Should-cost reviews as defined in the FAR have a role in the recent management initiative, but the initiative is broader in scope and intent than the meaning of *should-cost* in the FAR. The different conceptions of should-cost reviews and purposes of the analyses must be kept in mind when drawing lessons from historical experience.

Purpose

The sponsors of this research asked RAND to examine the Air Force's capability to conduct should-cost analyses, among other issues related to contract pricing. This report addresses only the subject of should-cost reviews related to contract pricing. The historical experience reviewed here does not include Air Force experience with the will-cost/should-cost management initiative from OSD begun in 2010.

The research team addressed two key research questions:

- What has been the Air Force experience with should-cost reviews?
- How can the Air Force enhance its capability to conduct should-cost reviews?

Recommended measures to improve outcomes are provided in the final chapter.

³ Will-cost estimates are cost estimates informed by historical experience with similar systems. In the management initiative, will-cost estimates are used to justify a budget for the program that provides enough resources to execute the program under normal conditions.

Research Approach

The research team used two main sources of information to address the key issues. Interviews with acquisition professionals involved in should-cost reviews of Air Force programs provided the primary source of information on recent experience. In addition, the team reviewed literature on the use of should-cost reviews by DoD and commercial businesses.

Interviews

The RAND team conducted interviews with current and former acquisition professionals, primarily from the Air Force but also from other DoD components and from the aerospace defense industry. The functional areas represented included pricing, cost estimating, and engineering. Interviews were semistructured or unstructured because the interviewees had diverse backgrounds and experiences for which a uniform and structured interview was not feasible, although questions tailored to each interviewee were provided to them in advance. Prominent interview themes were

- On what programs have you participated in a should-cost review?
- What was the composition of the team in numbers of people and their skills/functional areas?
- For reviews conducted recently, what training was provided?
- What was the duration of the review?
- What was the focus of the review?
- What was the outcome of the review?

Collectively, the interviewees participated in should-cost reviews of Air Force programs from the 1960s through 2011, although the interviews focused on reviews conducted from the late 1980s. Interviews with people still in the workforce were on a not-for-attribution basis, so the names of such individuals are not cited in this document.

The sample of experience represented here is in no way inclusive of all should-cost reviews conducted of Air Force programs. The interviewees represent a small sample of participants. We are unaware of any centralized record within the Air Force that has information on should-cost reviews that have been conducted, the names of participants, or results, which would allow a more comprehensive review of experience. What little written documentation of the Air Force experience with should-cost reviews that we could find is almost all open source. The interviews and experiences reported here represent sources of opportunity rather than a comprehensive report of the subject.

Literature

The team reviewed the literature on the use of should-cost reviews by DoD and on the use of should-cost and closely related analyses by commercial businesses. The literature on DoD use of should-cost reviews dates from 1970 to 1988. Despite its age, the literature highlighted the same issues and problems raised by interviewees on the most recent reviews. The literature on commercial use of should-cost and similar analyses included in the report dates from 1991 to 2011.

How the Report Is Organized

The next chapter contains a brief overview of the contracting environment and process in the Air Force, to provide a context for the reader about situations in which should-cost reviews might be used. Chapter Three addresses the first of two key questions examined during the research: What has been the Air Force experience with should-cost reviews? Chapter Four addresses the use of should-cost and similar analyses in commercial organizations. Chapter Five addresses the second key question examined in this research: How can the Air Force enhance its capability to conduct should-cost reviews? Chapter Six provides conclusions and recommendations.

Background on Contract Pricing and Negotiation in the Department of Defense Acquisition Environment

For major defense weapon systems, it is usually too expensive to fund more than one prime contractor to develop a system in the engineering and manufacturing development (EMD) phase. The government almost always selects one prime contractor to develop a weapon system, and that same prime contractor normally becomes the sole source for production of the system. The EMD phase is usually preceded by a “downselect” at Milestone B from multiple competitors that are researching technologies and designs to one prime contractor that will be given the opportunity to continue development into EMD.¹ Competitors for these contracts have a large incentive to bid low in order to win the development contract because they are normally cost-reimbursable contracts and because DoD usually awards future production contracts only to the contractor that developed the weapon system. Future contracts for sustainment of the weapon system may be at stake as well. Because there is generally competition for EMD contracts and a strong incentive for contractors to bid low to win the contract, the government does not need to devote effort to further reducing proposed prices. Contract pricing efforts focus on ensuring that proposed prices are realistic for the work that is to be accomplished, rather than trying to reduce them.

While many or most technologies used in the weapon system should be mature by Milestone B, the major engineering and integration tasks required to develop, manufacture, and test the final production article are usually considerable. Because a lot of technological and cost risks remain at Milestone B, it is typical to have the government bear those risks under a cost-reimbursement contract with a multiyear period of performance.² With cost-reimbursement contracts, the government pays all reasonable and allowable costs incurred by the contractor. Even if the government were to devote effort to identifying inefficiencies and negotiating a lower price on a cost-reimbursement contract, it makes little sense to do so. Unless an incentive fee arrangement is used on a cost-reimbursement development contract, there is little if any motivation for the contractor to control costs short of the costs rising so much as to risk program cancellation.³

¹ Milestone B is the decision point at which significant development activities commence.

² Over the past several decades, the government has occasionally tried to shift development cost risk to contractors through fixed-price contracts but has had limited success.

³ An incentive-fee arrangement would reduce contractor profit as costs rose above a certain target cost, or threshold. But the prospect of profits on future production and possibly sustainment contracts, after completion of development, might be more important to the contractor than loss of profit on the development contract. Competition to win initial sales in order to get profitable follow-on sustainment and spares contracts is typical in commercial aviation. See Sanders and Michaels, 2011.

After EMD, the same contractor normally becomes the sole source for production of the system. As sole supplier, a contractor negotiates with its sole customer, the government, to establish prices on production contracts.

In early production lots, when the configuration of the product may still be uncertain and manufacturing processes are not finalized, production contracts are typically cost-reimbursement. Production contracts that are cost-reimbursement are subject to cost realism analysis, just like cost-reimbursement development contracts, conducted both by cost estimators and pricers. However, because production of major weapon systems is usually sole source, the incentives for contractors on cost-reimbursement production contracts change because sole-source producers no longer have to worry about competition. Producers that are able to convince the government that the costs to do the work are high will be able to establish a high starting point before the production contracts transition to fixed-price types. Future negotiations will then be baselined off this higher starting point. The government thus has a strong incentive to try to negotiate lower prices, but this may be limited by the structure of cost-reimbursable contracts, which allow for the reimbursement for all reasonable and allowable costs.

In later lots, when technical and cost risks have been lowered, production contracts are generally fixed-price. It is on fixed-price production contracts that government pricing efforts can have their largest effects in lowering price by challenging contractors' costs in their proposals. The FAR advises that this is when should-cost reviews should be considered, as explained in the next section of this chapter.

The main objective of contract cost/price analysis is to obtain goods and services at fair and reasonable prices (Office of the Deputy Director of Defense for Procurement and Acquisition Policy for Cost, Pricing, and Finance, no date). In the Air Force, analysts who specialize in contract cost/price analysis make up a small subset of contracting personnel and are generally known as pricers. Some level of pricing analysis is required on all contracting actions. Air Force pricers typically perform the pricing function on large and complex contracts, while the contracting officer typically does this analysis on simple or lower-dollar-value contracts.⁴

Pricers typically conduct price and/or cost analyses, analyzing cost element-by-element, to assist in making a determination of a fair and reasonable price and negotiating to that target. Because data exist on prior production lots for the same weapon system, technical assessments are less important (assuming configurations remain the same lot to lot) and recent historical cost data become more critical in negotiations. Learning-curve analyses are often used to estimate prices of follow-on production lots.

As part of its larger study of contract pricing in the Air Force, the RAND research team attempted to collect information on the savings achieved by pricers, defined as the difference between the contractor's proposed price for a contract and the negotiated price.

The research team was able to obtain this information from one pricing location.⁵ The database from this location showed that proposed prices on contracts where pricers were involved were reduced by percentages averaging in the high teens over the past several years.

⁴ The Air Force Materiel Command Federal Acquisition Regulation Supplement sets the threshold for requesting pricing assistance at \$10 million at the Air Armament Center, Aeronautic Systems Center, and Electronic Systems Center locations that have centralized pricing support. The threshold is \$1 million at the logistics centers.

⁵ Although this information is recorded for individual contract actions, it apparently is not routinely organized and compiled in a database and was available from only one pricing office.

In deciding on various approaches to contract pricing and negotiation, one would like to know the savings achieved by each approach on similar procurements—that is, when done by the procuring contracting officer, when done with pricer support, and when done using should-cost estimates. This ideal comparison is difficult or even impossible to achieve in practice because different approaches are used in different circumstances, and the circumstances probably affect the potential for cost savings. The ideal comparison would hold constant such key conditions as the contractor, product or weapon system procured, and type of contract, and then compare outcomes using different pricing and negotiation approaches.

The next section of this chapter provides background on should-cost reviews as defined in the FAR.

Background on Should-Cost Reviews from the Federal Acquisition Regulation

It is important to understand that the FAR provides a definition of *should-cost review* that is narrower than the way the phrase is used in guidance from USD(AT&L) in 2010 and 2011 (Carter, 2010a, 2010b; Carter and Hale, 2011) and the Air Force guidance in 2011 (Morin and Van Buren, 2011). The FAR provides guidance for the contracting function, and the should-cost reviews described in the FAR are a specialized form of cost analysis used to identify inefficiencies and lower costs in support of contract negotiations. Because the recent USD(AT&L) and Air Force guidance also have the objective of reducing cost, the FAR definition is relevant here. However, different kinds of should-cost reviews can be and have been used for other purposes. For example, they can be initiated and used by companies seeking to improve their own operations. Additional examples are provided in Chapter Four, on the use of should-cost reviews in commercial organizations. DoD may use different kinds of should-cost reviews to obtain better understanding of the costs and status of programs rather than in support of a current contract negotiation.

What Is a Should-Cost Review?

Subpart 15.4 of the FAR provides the policies and procedures for the costing and pricing of proposed contracts. The ultimate goal of contract cost/price analysis is to arrive at a fair and reasonable price to be paid by the government to a contractor. Should-cost reviews are authorized by FAR 15.407-4; however, the regulation only broadly defines the ground rules and purposes of a should-cost review, identifies when a should-cost review should be conducted and the single product it is to provide, and outlines the personnel and organizational structure required.

According to FAR 15.407-4, a should-cost review is a specialized form of contract cost analysis. Its broad purpose is to lower the cost of production contracts by identifying, and establishing plans to eliminate, inefficiencies at contractor facilities. Its narrow purpose is to write a report about those inefficiencies that can be used to help determine the government's target price in contract negotiations.

Although a should-cost review does not substitute for price or cost analysis, it can be used to support proposal analysis, specifically to help the government “develop realistic objectives for negotiation” (FAR 15.407-4). Should-cost reviews can be small or large: They can target

specific concerns or examine the entire production process. No specific timeline for completion of should-cost reviews is provided.

FAR 15.407-4 specifies two distinct but complementary types of should-cost reviews: program and overhead. Program should-cost reviews examine direct labor hours and material dollars, tooling and facilities, labor skill mix, and production processes. Overhead should-cost reviews examine rates and all indirect charges to a contract, including profit. Program and overhead should-cost reviews can be conducted in tandem or separately, but the skills and experiences necessary to conduct them can differ substantially.

When to Conduct a Should-Cost Review

FAR 15.407-4 indicates that a program should-cost review should be considered, especially for major acquisition programs, when

- some production has already taken place and there are requirements for a substantial amount of future production
- costs are increasing
- the work (i.e., product) is well-defined enough to allow effective analysis and major changes are unlikely
- adequate time and personnel are available to conduct the review.

Overhead should-cost reviews should be considered for contractor sites that

- produce a major system
- have a high dollar amount of government contracts or a large number of proposals
- have a high level of government participation or noncompetitive contracts
- have been subject to changes in corporate organization, management, or accounting systems.

Should-Cost Review Analytical Methods

Like standard contract cost and price analyses, should-cost reviews can utilize a variety of methods, but, unlike standard cost or price analyses, should-cost reviews help estimate the cost of production assuming the most efficient existing production processes and technologies. Actual costs that embody historical or contractor-specific inefficiencies are to be disregarded as the basis for future costs.

FAR 15.407-4 does not require, recommend, or even state specific analysis methods (such as value engineering, industrial engineering, review of earned value metrics, or cost-improvement curve analysis). In Air Force experience, a variety of analytical methods have been used, as discussed further in Chapter Three.

Should-Cost Team Composition

The FAR does not specify what organization or function should lead the should-cost team, nor does it specify required team members. However, FAR 15.407-4 does recommend a “multi-functional team” of contracting, administration, pricing, and engineering personnel. For a program should-cost review, the contracting officer is assigned with identifying “elements of the contractor’s operation” with highest likely cost savings and matching available personnel against those areas. The FAR does not indicate which organizations are to provide these per-

sonnel. Similarly, no personnel management responsibility is explicitly assigned for overhead should-cost reviews.

Should-Cost Reports

At the completion of its analyses, the should-cost team summarizes its findings in a report. For a program should-cost review supporting a contract proposal, the should-cost team must write up findings and recommendations, which the program's contracting officer must take into account during contract negotiations. The contracting officer must then provide the administrative contracting officer (ACO) a report of all identified inefficiencies and how they were corrected or dispositioned, and establish a monitoring plan.

Overhead should-cost review teams must also write up findings; however, this report must be provided to the ACO, who must use it when negotiating forward pricing rate agreements. The ACO must establish a monitoring plan.

Latest Guidance on Should-Cost Reviews Supplemental to the Federal Acquisition Regulation

The Defense Federal Acquisition Regulation Supplement and its complementary Procedures, Guidance, and Information (PGI) resource provide additional guidance for implementing the FAR within DoD (Defense Procurement and Acquisition Policy, 2011). The guidance reflects laws, regulations, and policies. In the PGI that addresses contract pricing, updated May 18, 2011, the guidance dramatically broadens the criteria for conducting a program should-cost review, consistent with USD(AT&L) guidance: "DoD contracting activities should consider performing a program should-cost review before award of a definitive contract for a major system . . ." (Defense Procurement and Acquisition Policy, 2011, Subpart 215.4). Major systems are those with estimated research and development costs greater than \$140 million in FY 2000 constant year dollars or procurement costs greater than \$660 million in FY 2000 constant dollars.

What Has Been the Air Force Experience with Should-Cost Reviews?

This chapter presents the findings on the first of two key research questions addressed in this report: What has been the Air Force experience with should-cost reviews?

The chapter provides summaries of experiences with should-cost reviews and lessons learned in a few key areas, derived from a review of literature on DoD should-cost reviews and from interviews with participants in prominent should-cost reviews of Air Force programs.

Sources of Information on Air Force Experience with Should-Cost Reviews

The next sections address Air Force experience with should-cost reviews. Because there is no dedicated organization within the Air Force with responsibility for should-cost reviews and no dedicated place where information regarding them is retained, the study team had to gather information on historical experience from disparate sources. The experience was summarized from interviews with participants in Air Force should-cost reviews over roughly the past 20 years, from the little written documentation of the reviews that could be obtained, and from a literature review. The sources cover two time periods. The literature reviewed here dates from 1970 through 1988 and spans an era when the reviews were conducted more often than they have been subsequently. Little, if any, relevant literature was found after this time period. The interviews and written documentation encompass experience from the late 1980s through 2011.

We stress that many of the reviews discussed during interviews and found in the literature do not meet the FAR definition of a should-cost review, even though they are generally referred to as such. Some of the reviews are reactive responses to troubled programs rather than proactive analyses done as part of contract negotiations. We include this broad experience because similar prominent reviews are being done today, and the historical experience with reviews that do not meet the FAR definition may be helpful for similar reviews today.

We reviewed the literature to find some historical context for the Air Force's experience with should-cost reviews. We sought to understand when and why the Air Force began to use should-cost reviews. Then we focused on three aspects of the Air Force's experience with should-cost reviews that were most likely to be of interest to decisionmakers in enhancing the Air Force's current capability to conduct such reviews.

First, we were interested in the results. In particular, do should-cost reviews save money? There are various ways to measure savings. Savings on a sole-source contract can be calculated as a reduction from the price proposed by the contractor. But because the Air Force routinely

negotiates and achieves savings from proposed prices on sole-source contracts, a measure of savings that is of greater interest is a comparison of the savings achieved through the use of should-cost reviews to the savings achieved by other techniques, such as by a pricer using conventional forms of analysis.

Second, we were interested in the composition of the teams that conducted should-cost reviews. In particular, we wanted to determine the typical size of the teams, what functional areas of expertise were used, and the typical duration of the reviews.

Third, we were interested in the organizational support needed for the reviews and processes used in the reviews, especially any specialized training that was used or needed.

Literature Review Results of Air Force Experience with Should-Cost Reviews

Historical Context

The Air Force has had the capability to conduct should-cost reviews for at least 50 years. The Air Force used teams to assess the organization and management of its contractors in the 1960s. The first of these assessments, which were called Industrial Management Assistance Surveys, was done in 1960 and was described as somewhat comparable to a should-cost review. The Air Force conducted many surveys of smaller scope during the 1960s, although they were advisory in nature and not intended for use in contract negotiations (U.S. General Accounting Office [GAO], 1970).

The GAO found that although should-cost concepts were recognized in DoD policy, the analyses were rarely used, and historical costs were usually used as the basis for contract negotiations (GAO, 1970, p. 2). DoD officials at the time expressed the belief that contracting situations that required a should-cost review were rare and that if circumstances arose that required such a review, an ad hoc team would be preferable to establishing a permanent capability to do them (GAO, 1970, p. 13).

One of the big initiatives in OSD to improve cost estimating during this time was to require DoD contractors to report their costs in a standardized format and use the historical costs in the standard format as the basis for estimating the costs of similar future weapon systems. Advocates of this approach urged the use of competitive bids for fixed-price contracts as the best way to obtain low costs and better performance. An argument against the use of should-cost analysis was the large amount of data required (Fitzgerald, 1972).

In 1965, the Air Force awarded a fixed-price contract for development and procurement of the C-5A cargo aircraft, reflecting the policy preference for fixed-price contracts as the way to obtain low costs and better performance. The program experienced large cost overruns. Air Force Deputy for Management Systems A. Ernest Fitzgerald, on the staff of the Assistant Secretary of the Air Force for Financial Management, had looked into the problems on the program and was asked in 1968 to testify before the Joint Economic Committee of Congress.¹

¹ Fitzgerald is an industrial engineer by training who headed a small consulting firm that conducted should-cost analyses prior to his working for the Air Force. He was hired as a high-level civil servant by the Air Force in 1965. His testimony embarrassed Air Force officials, Fitzgerald's civil service tenure was revoked, and within a year the Air Force reorganized Fitzgerald out of a job. He was reinstated a few years later after lengthy litigation. Fitzgerald believed that the historical costs used to estimate costs of future similar systems contained waste that was perpetuated by using the historical costs as the basis for estimating future programs. He advocated estimating costs using bottom-up or engineering approaches that would arrive at what the product should cost if produced efficiently (Fitzgerald, 1972, pp. 26–28, 34–42).

After Fitzgerald's testimony to Congress about cost overruns on the fixed-price C-5A contract, in 1969 the Joint Economic Committee's Subcommittee on Economy in Government asked the GAO to explore the feasibility of using should-cost ideas in its assessments of contractor performance.

At the time of the 1970 GAO report, the GAO was conducting four trial should-cost reviews to assess what problems and benefits might be expected, and other issues. In 1971, the GAO reported on the results of its trial reviews. It found that should-cost reviews can be very beneficial and that procuring agencies that conducted the reviews prior to contract award would allow their negotiators to bargain from a stronger position (GAO, 1971). The report noted that the Air Force had started its first should-cost review (p. 19). By the early 1970s, should-cost reviews were used more widely within DoD.

Do Should-Cost Reviews Save Money?

We found two studies that made a rigorous attempt to answer the question of whether should-cost reviews save money, and one early and less rigorous assessment by GAO. The studies compared the savings achieved by should-cost reviews with the savings achieved using other contract negotiation methods.

The GAO assessed five should-cost analyses conducted by the Air Force between the fall of 1970 and January 1973. The GAO compared the price reductions achieved in negotiations using should-cost reviews on five contracts with the reductions achieved on the same programs using other negotiation methods. The GAO found that should-cost analysis resulted in higher savings in four of the five cases. The GAO specified the difference, of 7 percent, on only one of the contracts. The GAO also added the caveat that the negotiated amounts did not necessarily result in savings to the government because four of the contracts were fixed-price incentive (FPI) contracts on which the final price would not be determined until the contract was complete (GAO, 1973).

The objective of the second study was to compare cost outcomes on contracts negotiated with the use of should-cost reviews to contracts negotiated without such reviews (Schaefer and Birkhead, 1975). The study's sample began with 17 FPI contracts for which should-cost reviews were used. FPI contracts were selected because, unlike firm fixed-price contracts, the FPI contracts were subject to a redetermination of costs after the contract was completed so that the government had access to the final cost data. This restriction was necessary because the authors wished to measure cost savings at five stages in the contracting process that included the potential for contract modifications to be used to increase contract costs, and thus final contract costs were required. Of the 17 contracts, only four had final cost data available. For comparison, the study authors selected four contracts with the same manufacturer and for the same product, but negotiated with methods other than should-cost.

The five stages that were compared were

1. proposed value to negotiated value
2. proposed value to completed value
3. revised (by contract modification) value to completed value
4. cost of revision as a percent of proposed value
5. cost of revision as a percent of negotiated value.

The authors found no significant difference in cost outcomes in any of the five stages (Schaefer and Birkhead, 1975, p. 56). The extremely small sample size, however, limits the conclusions that can be drawn from the study.

The third study we found that attempted a rigorous assessment of should-cost results was similar in methodology to the second study and analyzed matched pairs of contracts for the same weapon system and contractor, with one contract using should-cost and the other using a different negotiating method (Conway and Howenstine, 1983). The authors stressed that their data were based on a convenience sample of available data, used because of a lack of historical contract data. Then as now, the Air Force had not established a central repository for data on should-cost contracts, and in many cases the organizations queried did not maintain or were reluctant to search for the type of data needed to perform their analysis (Conway and Howenstine, 1983, p. 28).

The authors compared the percentage change in negotiated price from the proposed price and found no statistically significant difference in the eight matched pairs of Air Force contracts (Conway and Howenstine, 1983, p. 43). The authors urged caution in interpreting the results due to the small sample size.

A less-controlled assessment was made by A. Ernest Fitzgerald. He found that the success of the early should-cost analyses and other cost-control efforts in reducing cost to the government was mixed at best. Fitzgerald wrote that, as a consultant conducting should-cost reviews of large weapon system programs in the 1960s, there was never difficulty in finding places to save money. "All of them were as fat as lard hogs," he writes; the difficulty was in getting action (Fitzgerald, 1972, p. 6). In 1972, by which time DoD had adopted the use of should-cost pricing, Fitzgerald argued that the approach had changed to "subjective, qualitative reviews" that saved very little money. Even when potential savings were identified, they were seldom realized because they were not negotiated or were given back to the contractor in subsequent contract changes (Fitzgerald, 1972, p. 363).

What Is the Composition of Should-Cost Teams?

The second issue we wished to investigate in the literature review was the composition of should-cost teams.

Fitzgerald (1972) indicated that early should-cost activities conducted on aerospace programs utilized a small, highly trained cadre of industrial engineers who compared the efficiency of production processes at contractor plants with industry best standards. For analyses requested by and conducted for the manufacturer, no contracting or pricing team members were needed.

After reinstatement to his Air Force job in the early 1970s, Fitzgerald continued to be involved in should-cost reviews and other cost-control efforts until his retirement in 2006. In an interview conducted in 2009, he continued to recommend work-measurement techniques for should-cost reviews today: benchmarking actual hours versus standard work hours for each production process and using the resulting information to determine which areas need the most focus.²

The Air Force had a *Should Cost* pamphlet, designated Air Force Pamphlet (AFP) 70-5 and now obsolete, that provided guidance on the use of should-cost reviews, including guid-

² Interview with A. Ernest Fitzgerald, retired Air Force Financial Management and Comptroller staff member, 2009.

ance regarding composition of the teams (Headquarters U.S. Air Force, 1989). The guidance called for integrated teams formed of government acquisition, contracting, contract administration, pricing, auditing, and technical representatives. According to the pamphlet, the team should be composed of highly skilled, dedicated people available for full-time duty; a mix of people familiar with the contractor's operations and outside experts is desirable; and the team should be headed by a chief at the GM-15/colonel rank or higher (p. 4). The pamphlet states (p. 5) that the procuring organization should be strongly represented, especially by the procuring contracting officer, technical experts in engineering, manufacturing, logistics, and other technical areas as needed, and one or more price analysts; and that the principal negotiator and the contracting officer or a designee should be full-time members.

The Army's 1972 *Procurement: Should-Cost Analysis Guide* cites teams composed of specialists in engineering, pricing, audit, procurement, and management (U.S. Army Materiel Command Headquarters, 1972, p. 1-1). In addition to technical skills, the guide advises that good skills in oral and written communication, including the ability to communicate across disciplines, are important. The guide advises that the single most important attribute in team members is high motivation, which is required because of the long work hours and absence from home and family (p. 3-3). The guide also advises that the number of members on the team and the mix of skills depend on the nature of the task (p. 3-4).

Weida and Sloan (1972) analyzed the participation of specialists from the Air Force plant representative offices in Air Force should-cost studies and found that industrial engineers were the most utilized specialty, followed by pricers. Other specialists included development engineers, contract specialists, and quality engineers (pp. 99-100).

Ulrich (1973) also found that the two most commonly desired functional specialties on should-cost teams were industrial engineers and price analysts (p. 85). He noted that inadequate writing skills have plagued should-cost teams, and in particular that the inability of the teams to support their position in writing is a serious handicap to the contract negotiator (p. 99).

Williams (1985) found that teams ranged in size from eight to 80 members and that the duration of the reviews ranged from a few weeks to several months (p. 24).

What Was the Organizational Support and Process for Conducting Reviews?

The third issue we wished to focus on in the literature search was the organizational support required for should-cost reviews and the processes for conducting the reviews, especially any specialized training that was used or needed.

Weida and Sloan (1972) considered the establishment of a permanent organization within the Air Force to support should-costs. They argued that a permanent organization is desirable only if top-level management supports the concept of a should-cost capability (p. 124). The two main areas of support needed would be additional manpower and additional training in the concepts and analytical methods of a should-cost study. They noted the need for a training and resource center that would maintain a library of reference material, provide consultant services, prepare and maintain a should-cost guide, and provide training using lessons learned from previous studies (pp. 126-128).

Regarding the process of conducting the reviews, Heitman and King (1984, p. 97) found a need for more guidance for planning the reviews. They found that the sources of information most helpful in the planning process were (1) information pertaining to the contractor, (2) pre-

vious should-cost reports, (3) previous experience, and (4) AFP 70-5 (the Air Force guidance on should-cost reviews, which is no longer published).

Williams (1985) wrote that “Research indicates that the vast majority of problems that are encountered during a Should Cost analysis are due to insufficient planning, insufficient time to properly plan the evolution, or failure to include the contractor’s input” as to what is needed for a successful analysis into the plans (p. 24). Williams stressed the need for an adequate number of highly skilled personnel to conduct the analysis and wrote that planning includes contact with the contractor to determine what resources are needed to conduct the analysis. He also emphasized that should-cost reviews are only a tool that can be useful in the budgeting or contract negotiating process. The reviews produce estimates given certain assumptions and conditions, but if the assumptions or conditions change or are not achieved, the estimates will no longer be valid. He warned that should-cost analyses are not a panacea to the problem of cost overruns (p. 25).

To make effective use of the should-cost review, Williams argued that senior officials must be involved; that the team leader should be given a written charter that identifies the task, authority, etc.; and that the chief contract negotiator must have in-depth knowledge of the should-cost report. For this reason, the team leader has traditionally been the chief negotiator (pp. 44, 45, 55).

Interview Results of Air Force Experience with Should-Cost Reviews

In addition to conducting a literature review on the subject of should-cost reviews, we conducted interviews with participants in Air Force should-cost reviews. The interviews covered reviews conducted from the late 1980s through 2011. In many cases, analyses that were described as should-cost reviews did not meet the FAR definition. For example, some of the analyses have been conducted on ongoing development programs, whereas the FAR guidance is to consider should-cost reviews for production programs with well-defined technologies and designs, when production processes are set. Furthermore, in the cases of analyses of development programs, the contract had already been signed, so that review results could at best be used to inform negotiations on contract modifications.³

Few written records of these more recent reviews were found, so that in most cases we had to rely solely on the recollection of the participants. The following section describes the goals, organization, and results of these reviews.

1980s: B-2

In the mid-to-late 1980s, an overhead should-cost review was conducted for the B-2 bomber program. Sponsored by the commanding general of Air Force Systems Command, predecessor of part of the current Air Force Materiel Command, it was focused on cost control. The primary goal was a better understanding of contractor overhead. The key deliverable was a new forward pricing rate agreement at Northrop, the prime contractor. The review was performed onsite at Northrop in Southern California, at Boeing in Seattle, and at Vought in Texas.

³ Some participants believe that should-cost reviews can be useful during development to reveal hidden assumptions underlying the program and to provide insight into the potential for future cost growth or technical challenges.

The review was complicated by the classification of the program. Anywhere from 80 to 100 people were on the overall team, which was led by an Air Force colonel. A few subteams formed, each working for several weeks at a time. The overall review required 16 weeks, including writing the reports and negotiations.

Many costs of doing business were impossible to reduce (e.g., an extremely large number of personnel in security). A senior government executive successfully negotiated the contractor overhead rates down. Despite these negotiations, the rates eventually rose slightly higher than the contractor's original position. Our interviewee believed that this was a less-than-successful should-cost review.⁴

1990s: F-22

A should-cost review of the F-22 program was conducted in the early-to-mid 1990s, analyzing both development and planned production (production would not start until 2000). Three teams went out to major contractor locations—Fort Worth, Texas; Marietta, Georgia; and Seattle, Washington. The engine program was not reviewed.

The should-cost review addressed consolidation issues raised by the purchase by Lockheed of General Dynamics' Fort Worth plant. The government believed that consolidation of personnel should have driven considerable improvements in costs. However, Lockheed was reluctant to reduce employment despite the consolidation, resulting in little cost reduction.

Costs were adequately represented and understood on both sides. While the review generated considerable technical understanding, better cost estimates, and a higher degree of confidence, it did not result in lower costs on the F-22 program. Interviewees did not believe the government review drove contractor behavior to reduce cost or cost growth.⁵

1990s: C-17

A sequence of should-cost reviews was conducted on the C-17 program in the 1990s. The review conducted in 1994—described as the “celebrity should-cost” by one interviewee because so many high-level officials were involved—received the highest level of attention inside the Air Force. Some analysts considered it the most successful should-cost review of those noted here.

Development and procurement costs had risen dramatically on the C-17 program from baseline estimates, and average unit procurement costs of early production lots remained high in the early 1990s. The purpose of the 1994 review was to save the program from being cancelled. USD(AT&L) had indicated that unless the program was both technically and cost stabilized, no more than 40 aircraft would likely be bought. Making this threat credible, the government was considering a modified Boeing 747 and a C-5 variant as alternatives. Hence, the contractor, McDonnell-Douglas, was motivated, as was the Air Force. A fully integrated contractor and government team was formed, with top-level corporate and Air Force leadership. The should-cost review team lead was the government program director, an Air Force general officer. However, the review team's day-to-day operations were run by an Air Force colonel.

About 40 people were on the team. The review lasted from 12 to 16 weeks, and subteams rotated in and out of locations periodically. A dozen full-time core personnel spent six to eight weeks at Long Beach, with the other personnel spread out over the duration of the review. They

⁴ Interview with Defense Contract Management Agency staff member, 2009 (name withheld by request).

⁵ Interview with Defense Contract Management Agency staff member, 2009 (name withheld by request).

examined touch labor, engineering, and overhead. The contractor provided subteam leaders to the review team, providing excellent exposure at the working level.

In a cooperative effort with the company, the review team developed a consensus cost position for the follow-on 40 units. The team identified significant cost reductions in both overhead and technical areas.

The overhead review team found economies of scale in purchasing and found substantial cost savings in schedule stability and a multiyear buy. A small, experienced team worked the schedule and production rates. Most other issues (e.g., the number of engineers in overhead, marketing and process studies) were left for management and program personnel to negotiate.

The C-17 program continued production, with more than 200 aircraft delivered by September 2010. The average procurement unit cost decreased significantly in later years, in large part due to the economies achieved with annual production rates higher than the six aircraft per year bought in 1994.

1990s: T-6 Joint Primary Aircraft Training System

The Air Force began low rate initial production of the Joint Primary Aircraft Training System in 1995. It appears that the prime contractor, Raytheon, had counted on additional sales in a robust international market to lower unit costs of the trainer aircraft. However, there had been no international sales, and Raytheon's costs of production were higher than the price the government was paying. Because the existing contract was firm fixed-price, this led to large losses.

In 1995–1996, a small overhead should-cost review team was formed comprising 10–12 people for a six-week core period, and other personnel for a six-month period. The team was sourced from the Air Force, the Defense Contract Management Agency (DCMA), and the Defense Contract Audit Agency.

Review participants had mixed opinions regarding the outcome of the review. One participant believed the review did not lower costs to the government but did result in better understanding and insight of the competitive situation, and that the Air Force used the review to inform its acquisition strategy for the follow-on contract.⁶ (As noted, Raytheon lost money on the initial firm fixed-price contract, and the unit cost to the government of the T-6 increased on the subsequent production contract.) Another participant believed that the review resulted in lower production costs than were originally proposed for the follow-on contract.⁷

2000s: Global Hawk, Evolved Expendable Launch Vehicle, and Global Hawk Again

In 2002–2003, the Air Force conducted an overhead and program should-cost review of the Global Hawk program. Some critics believed that the unmanned aircraft should be as inexpensive as the less-capable Defense Advanced Research Projects Agency prototype, which was delivered for \$10 million. The review teams examined this possibility.

The review quickly noted that the Defense Advanced Research Projects Agency had flown an airframe, not a complete system. Once reliability improvements were made and sensors, cameras, and communications were included, the cost would easily become \$75 million each.

In looking for ways to reduce costs, the program review team assumed that not every Global Hawk had to do every mission. Vehicle configurations could be tailored to different

⁶ Interview with Defense Contract Management Agency staff member, 2009 (name withheld by request).

⁷ Interview with retired Air Force engineer, 2009 (name withheld by request).

missions. The team looked at requirements and discussed with the user how to relax requirements. The team worked with the Air Force, the prime contractor, and suppliers to explore what could be done to improve producibility, including adding funding to reduce recurring costs and generating competition for avionics suites.

The team was able to achieve savings from proposed prices in avionics.

The Air Force conducted two prominent should-cost reviews in 2010. Another review of the Global Hawk program was led by the Air Force Cost Analysis Agency. The other prominent review was directed by the Secretary of the Air Force, who chose the Director of the Air Force's Office of Small Business Programs to lead a team to conduct a review of the Evolved Expendable Launch Vehicle (EELV) program. Although the analytical work of both reviews has been completed as of the writing of this report, it is too soon to determine the results in terms of cost reductions.

The 2010 Global Hawk review was especially unusual in that the team was small and composed mostly of cost analysts. They identified potential savings in the air vehicle and payloads. Subject-matter experts familiar with the program were difficult to find.

The EELV review, by contrast, was much larger and more diverse in the composition of its team. A roster of participants shows 100 members assigned to the direct portion of the review and more than 40 assigned to the overhead portion of the review. Six more members were from the Defense Acquisition University (DAU). Based on interviews, the number of active participants was probably smaller than the total number of people on the roster. Areas of expertise on the team included cost analysis and estimating, pricing, contracting, and subject-matter expertise in avionics, propulsion, and other areas related to launch services and capabilities. The team members represented many organizations from throughout the Air Force as well as NASA, various support contractors, the Navy Price Fighters, DCMA, and DAU.

A brief orientation on should-cost reviews was provided at the beginning of the effort by DAU, and some training was provided by one of the support contractors.

The bulk of the effort took five months to complete.

One of the participants in the EELV study had also participated in similar reviews during the 1990s of other large weapon system programs. He said that although the reviews were not termed should-cost reviews, they were done fairly routinely for large weapon system programs in the Navy. He described the primary methodology used on the EELV review as auditing or analysis of proposals and other financial data. When asked about other methodologies cited in the literature or by other advocates, such as industrial engineering, he claimed that although the government may have industrial engineers capable of the analysis, it would be prohibitively time-consuming and labor-intensive for government engineers to become familiar with a contractor's manufacturing process and independently evaluate the analysis. He said that on other reviews, including those of the C-17 and V-22 programs, the prime contractor conducted industrial engineering studies and then collaborated with the government should-cost teams. In addition, the C-17 and V-22 contractors were conducting ongoing industrial engineering reviews and manufacturing improvement efforts to reduce costs. These were distinct efforts from the should-cost reviews but were used by the should-cost teams in the development of their estimates.⁸

⁸ Interview with Air Force Cost Analysis Agency cost estimator, 2010 (name withheld by request).

Recent Should-Cost Experience of Other DoD Organizations with Air Force Programs

We also spoke with people in two organizations outside the Air Force that had conducted should-cost reviews on Air Force programs. DoD's foremost dedicated capability to conduct program should-cost reviews resides with the Navy's Price Fighters organization.⁹ The Price Fighters workforce consists of roughly 60 civilians, mostly industrial technicians and engineers with cost training, assisted by support contractors. The Price Fighters organization is an industrially funded activity and is able to accept funding from, and work for, other government organizations.

The Air Force has hired the Navy Price Fighters to help provide negotiation objectives in several cases. Most notably, the Price Fighters have worked on the C-130 center wing box, the C-17 global sustainment program, the C-27 program, and the EELV should-cost, as mentioned above.

Representatives of the Price Fighters claimed to have achieved percentage savings from proposed prices in the high teens and up. They explained that outcomes vary depending on the buying organization. Different organizations and individuals within DoD have differing capabilities and appetites to negotiate lower prices, but the Price Fighters can enhance these capabilities with actionable information.¹⁰ This insight from DoD's preeminent organization for conducting should-cost reviews indicates that the analytic capability is only part of the battle. Achieving real savings depends on additional circumstances, including the ability and willingness of the procuring organization to negotiate lower prices.¹¹

A much more limited capability for should-cost analysis of individual spare parts exists at the Defense Logistics Agency's (DLA's) defense supply centers. Small groups of engineers use various techniques to analyze proposed prices for parts. They may check the prices of previous buys or prices for similar parts on other platforms. If sufficient technical information on the part is available, they may use computer software models to estimate costs and determine whether individual spare parts on sustainment programs can be procured more cheaply.

At the Aviation Supply Center in Richmond, engineers work on spare parts on aircraft sustainment programs. Should-cost estimates are tracked to determine whether the contracting officer used the should-cost estimate in the buy; if so, savings from proposed prices are calculated. The organization in Richmond did not express the savings in percentage terms, but reported that it has achieved a high return on investment for its small staff.¹²

⁹ The Price Fighters Department is located within Naval Supply Systems Command, Naval Inventory Control Point. More information on the organization's staffing and training is provided in Chapter Five.

¹⁰ Interview with Navy Price Fighters staff members, 2010 (names withheld by request).

¹¹ Various participants in contract negotiations have offered several potential explanations for this. Explanations include inadequate training or skill in negotiating, aversion to conflict, lack of interest in saving money if enough funds are budgeted to execute the program, and a desire to stay on good terms with the contractor by those who are retiring soon from government service and wish to work for the contractor.

¹² Interview with Defense Logistics Agency, Aviation Supply Center, staff member, 2009 (name withheld by request).

Summary of Experiences

Results

We found scant literature addressing the question of whether should-cost reviews result in savings compared with other forms of contract pricing and negotiation. Such comparisons would provide the most compelling evidence of the efficacy of should-cost reviews. Of the three studies we found that addressed the question, two found no significant difference in results, but the studies were limited by very small sample sizes. The 1973 GAO study was also limited by a very small sample size. It found savings in negotiated prices, which were specified on only one contract and which did not reflect final costs incurred on the fixed-price incentive contracts. Opinions expressed during interviews regarding savings were mixed. The savings claimed from should-cost reviews by the Navy Price Fighters and by DLA's Aviation Supply Center for spare parts are substantial.

Team Composition and Methodology

Should-cost review team size and composition vary greatly depending on the scope of the review and size of the program. The trend toward outsourcing adds complexity by increasing the number of contractors with significant work share, locations, and accounting systems. Team size and mix differ depending on scope, program size, and number of subcontractors; whether the review is a program review, an indirect review, or both; and other considerations. Typical disciplines include cost estimating, pricing, contracting, and subject-matter expertise in the technology embodied in the program being reviewed.

The analytical methodologies used in should-cost reviews vary and have included industrial engineering, parametric cost estimating, auditing, and application of alternative economic or business strategies. Literature on early experience with the reviews indicates the participation of industrial engineers much more often than in recent experience. Similarly, literature on early experience emphasizes the importance of the role of contracting officers, who ultimately use the knowledge gained from the reviews in contract negotiations, whereas interviews with participants on more recent efforts suggest less participation of contracting personnel.

Finding people with the necessary skills who are highly motivated and capable can be difficult. The numbers of people with skills traditionally used in should-cost reviews, such as pricing and industrial engineering, has decreased, and many of the required capabilities are in short supply. Compounding the difficulty is that participation on a should-cost team takes people away from their regular duties and usually requires travel and extraordinary workloads. Teams have often augmented organic personnel with civilian and military retirees, federally funded research and development center staff, and support contractors.

Organizational Support

Organizational support for should-cost reviews can be thought of as spanning a range. At a high level, political pressure or acquisition strategies may align powerful forces in support of a contractor or weapon system. At this level, organizational support may take the form of the willingness of the Air Force to reduce the cost of a program or overhead cost structure at a contractor facility or even cancel a program. At a low level, organizational support takes the form of providing the resources, in the form of people and training, to do the analysis.

At a high level of organizational support, should-cost reviews put the government in a difficult position of having to evaluate the efficiency and reasonableness of private contracts

and labor agreements. A program should-cost review may estimate the hours, labor mix, and methods required for production. An overhead should-cost review may examine contractor employee compensation, benefits, and retirement plans. Assessing compensation is always sensitive. There is a tension between realism, including what can be achieved politically, and efficiency. Savings that are identified in principle may not necessarily be achievable in practice. The reviews are practical exercises that are influenced by the exigencies of the day. For all these reasons, clear direction and top-level support by the Air Force leadership are essential to achieving results.

Several reviewers of an earlier draft of this document emphasized that success was more likely when the government had the leverage of a credible alternative, such as the ability and willingness to cancel the program or at least reduce proposed buys. This is an example of a high level of organizational support.

At a lower level of organizational support, should-cost teams need adequate numbers of people with the right skills and training. It is not clear that these resources are being provided for recent reviews. The composition of teams has changed over time, with less participation by industrial engineers and pricers. Team compositions may have changed because these skills were not needed, which seems unlikely, or because personnel in these small and specialized fields were not available.

Similarly, recent teams have received little training on should-cost reviews. The EELV team received an overview of the concept of should-cost reviews from DAU and some training from a support contractor. The Global Hawk and F-35 teams did not receive training.

The Use of Should-Cost Analysis and Similar Techniques in Commercial Businesses

This chapter provides a brief discussion of the use of should-cost analysis and similar techniques in commercial businesses. This review of commercial practices is included in the report for two reasons. First, most of the literature on should-cost analysis within DoD is old, whereas there is a rich literature on commercial practices that reflects current practices. Second, it is plausible that the current ways of thinking about relationships with suppliers and the use of should-cost and similar techniques within DoD have not kept pace with commercial best practices, and that notions about the use of should-cost analysis within DoD could benefit from how such analyses are used in industry.

This review of the literature on commercial practices is intentionally brief. The review was limited to focus narrowly on the use of should-cost analysis and similar methods in commercial businesses. Not all commercial practices are relevant to DoD, thus we focus here on those that are most applicable.

Differences in Buying Environments Between DoD and Commercial Business

DoD has a relationship to its suppliers that is unlike the relationship of most commercial organizations with their suppliers in a few important ways, and it is important to keep these differences in mind when considering lessons from commercial experience. One key difference is that most commercial organizations compete in an environment in which they face constant market pressure to improve cost and performance. These pressures provide organizations the motivation to seek improvement in processes and products from themselves and their suppliers. In contrast, DoD is a government-funded entity that is essentially the sole, or at least dominant, buyer of weapon systems.¹ DoD generally pays a single prime contractor to develop a weapon system to DoD specifications, then buys the weapon system from the same contractor. There are often few prime contractors capable of competing for the development of large and complex weapon systems, and once the development contract is awarded, there is seldom competition for the production contracts. Pressure to control cost varies depending on the

¹ Many U.S. weapons systems also have foreign military customers that buy the product after it has been developed for DoD, and generally after DoD has bought the earliest and most expensive production units. The government reviews and approves these sales to ensure they are in accordance with U.S. foreign policy objectives and to protect sensitive technology. In rare cases, such as the F-35 program, foreign militaries contribute to the development of a weapon system that is predominantly funded by the United States. Nevertheless, DoD has by far the largest budget of any buyer of U.S.-made weapon systems.

political environment, and those pressures may or may not affect individual program offices or procuring organizations, depending on such circumstances as the generosity of the budget for the program or popularity of the program, so that participants may feel less motivation to control costs than in the commercial sector.

A second difference between purchasing in DoD and in commercial organizations is that most of the organizations cited in the literature on commercial practices have engineering and manufacturing experience and expertise in the product they produce, and they are able to use this expertise to conduct should-cost and similar analyses of the parts of their products that they buy. In contrast, DoD does not build weapon systems. Few DoD personnel have direct experience with the design or manufacture of products, although the government does have industrial expertise in its labs, depots, and other repair organizations. DoD is able to work around this problem by hiring people with the needed skills to serve on should-cost studies.

A third difference is that the commercial market offers relatively clear feedback or metrics on the success of products and cost-reduction efforts. It is more difficult to measure the success of government products or services.

These differences between DoD and commercial buying environments also explain why DoD buying practices may lag behind the state of the art in the commercial world. For this reason, a review of commercial practices can be thought-provoking.

While acknowledging that DoD and commercial companies operate in environments and have relationships with their suppliers that differ in important ways, we highlight examples from the literature on commercial practices that provide insight into three areas relevant to the use of should-cost in DoD: the nature of the relationship with suppliers and the pricing approach appropriate to the relationship; organizing and staffing for effective buying; and the purposes served by the use of should-cost analysis and similar techniques.

Clarification of Terms Found in Commercial Literature

Before sampling the literature, it is helpful to clarify the terms *should-cost analysis*, *reverse cost analysis*, and *target costing* or *target pricing*, which are found in the literature on commercial practices. In the discussion of DoD should-cost analysis, we have focused on the in-depth cost analyses conducted by multidisciplinary teams at contractor locations, although the quick analyses of individual spare parts prices at DLA defense supply centers was also noted. The commercial literature includes references to should-cost analysis of both these types. Reverse cost analysis is useful when suppliers are reluctant to share cost information. In this narrower type of analysis, publicly available information or the purchaser's engineering judgment may be used as sources of information on supplier costs. This method is known as reverse cost analysis or as should-cost analysis (Monczka, Trent, and Handfield, 2001).

Target costing or target pricing is another type of cost analysis that is similar to should-cost analysis. Monczka, Trent, and Handfield describe target pricing as a method used in initial product development. The price willing to be paid by the customer is an input to the design process and serves as a constraint on how much the product can cost. The cardinal rule of target pricing is that the target cost must never be violated (Monczka, Trent, and Handfield, 2001, p. 443). This approach is akin to the cost as an independent variable (CAIV) approach used in DoD during the 1990s.

The Nature of the Relationship with Suppliers and the Appropriate Method of Cost Analysis

Both commercial organizations and DoD have evolved in their thinking and practices regarding the nature of their relationships with suppliers. The nature of the relationship is important because it should inform the types of cost analyses used by purchasing organizations. The literature on commercial practices provides ideas for determining the appropriate relationship.

Ellram (1996) provides a conceptual framework for determining the appropriate method of cost analysis for a purchase. The framework classifies purchases along two dimensions: (1) whether they are ongoing or one-time and (2) whether the relationship sought with the supplier is arm's-length or a strategic alliance. This results in a matrix that categorizes four types of purchases. For purchases from suppliers that the buyer wishes to hold at arm's-length, one-time purchases or repetitive low-dollar purchases are considered "low-impact," while continuous purchases are considered "leverage purchases." For purchases from suppliers with whom the buyer wishes to have a strategic alliance, one-time purchases are considered "critical projects," and continuous purchases of important items are considered "strategic purchases" (Ellram, 1996, Figure 1).

Ellram goes on to identify cost analysis techniques appropriate to each type of purchase. For low-impact and leverage purchases from suppliers with whom the purchaser has a more arm's-length relationship, the techniques are simpler and make more use of publicly available price information rather than shared data. Cost analysis techniques appropriate for critical projects and strategic alliances are more sophisticated and make more use of shared data. In particular, should-cost analysis is identified as appropriate for leverage purchases, while more collaborative techniques, such as target costing, are appropriate for strategic purchases (Ellram, 1996, Figure 2),

As any DoD cost estimator or contract price analyst knows, the ability to conduct cost analysis depends on the quality and availability of the data. This is true in DoD as well as commercial organizations. Cost data will be more difficult to obtain when the buyer and seller have a more distant relationship (Monczka, Trent, and Handfield, 2001, p. 443). In DoD, statutes and regulations require contractors to provide detailed cost information under certain conditions.

In commercial practice, competitive pressure has forced most purchasers to develop closer relationships with their suppliers in an effort to continuously improve processes and costs. The closer relationships have required a willingness to share cost information. "The last frontier of information exchange between firms is the detailed sharing of supplier cost data" (Monczka, Trent, and Handfield, 2001, p. 442). Most North American supply firms have been reluctant to share this information. Despite these fears, target- and cost-based pricing are increasingly being seen as beneficial (p. 443).

It is interesting to note that while there has been a reluctance to share cost data and collaborate in improving process among suppliers in the United States, world-class manufacturers elsewhere have practiced these techniques for decades. Over 20 years ago, Womack, Jones, and Roos documented the use of target pricing and other collaborate practices between buying organizations and suppliers in the Japanese auto industry in their book *The Machine That Changed the World* (1991, Chapter 6).

An example of collaborative practices between a buying organization and its suppliers is Honda of America. At Honda, suppliers participate in the development of new Honda prod-

ucts. Engineers from suppliers work together with Honda engineers in the early phase of vehicle development to use the suppliers' expertise and help develop the best design in the shortest amount of time. The collaboration includes joint efforts in cost reduction using value engineering and other techniques (Honda Supply Team, 2011).

It is also interesting to note that long after some world-class manufacturers adopted closer collaboration and cost sharing among suppliers, and while such practices were increasingly being viewed favorably by commercial organizations in the United States, legislation and practice within DoD during the 1990s and early 2000s were moving away from the sharing of cost information. Lorell, Graser, and Cook (2005) describe in *Price-Based Acquisition: Issues and Challenges for Defense Department Procurement of Weapon Systems* the belief popular in the 1990s that use of market pricing rather than more detailed cost information would reduce the cost and acquisition time for major weapon systems, and the acquisition reform legislation and DoD practices that flowed from this belief. Several years after the implementation of these reforms, the authors were unable to find evidence of meaningful cost savings attributable to the implementation of price-based acquisition (Lorell, Graser, and Cook, 2005, p. 60).

Organizing for More Effective Cost Analysis and Buying in Supply Chain Management

It is also instructive to note how commercial entities organize themselves to become more effective buyers. This lesson includes how effectiveness is measured and what kind of people or skills are used.

Ellram's 1999 study examined the use of target costing at 11 organizations, which included manufacturing and nonmanufacturing firms. She found that target costing is best performed by cross-disciplinary teams (Ellram, 1999, p. 12). Primary responsibility for the target costing process within the organization is often shared between purchasing and research and development or engineering (p. 38).

Ellram's 2002 study examined best practices in strategic cost management at five large manufacturing companies. She found that all five companies had a centralized or mix of centralized and decentralized purchasing organizations. Cost management specialists, either from the purchasing and supply management organization or from finance, were the focal point for analysis. They built cost models, conducted supplier and should-cost analysis, and validated results (Ellram, 2002, p. 13). The organizations made sure that they had people with the right expertise involved, and this generally meant finance or cost management people (p. 14). The techniques used include benchmarking of prices and processes, target costing, should-cost analysis, and total cost of ownership. Among the key success factors to strategic cost management were (pp. 17–18)

- high-level visibility and reporting relationships
- the availability of trained and dedicated personnel to support supplier cost analysis
- credibility of the numbers reported
- cost management as a priority throughout the organization
- collection of cost data, and information systems with the data to allow analysis.

Fearon and Bales (1997) studied what measures of purchasing effectiveness were considered to be useful by chief procurement officers (CPOs) and chief executive officers (CEOs), as well as which measures were actually used by CPOs. CEOs and CPOs provided separate responses for the measures that were assessed as being useful and which ones were actually used. When assessed value and usage were combined, the three highest-rated measures were (1) price negotiations resulting in savings, (2) use of leverage through combining volumes, and (3) past delivery performance (p. 11).

In the *Supply Performance Management Benchmarking Report* (2005) issued by CAPS Research, 38 companies rated the effectiveness of strategies that helped achieve cost reductions. Should-cost analysis received a mean score of 2.57 on a scale from 1 (not effective) to 5 (very effective). Other strategies, such as re-sourcing/competitive bidding and re-negotiations, were deemed more effective. On average, over half of supplier products were multiple-sourced by the companies that responded, with an additional roughly one-third using single sourcing. Only roughly 11 percent of the supplier products were sole-sourced.²

Examples of the Use and Purposes of Should-Cost and Similar Techniques

The following examples illustrate the use of should-cost and similar techniques in diverse industries and the purposes for which the analyses are conducted.

The 1970 GAO report *Feasibility of Using "Should Cost" Concepts in Government Procurement and Auditing* described the use of should-cost concepts in industry and found that they were used pre-award and post-award and that it was not uncommon to send engineers and other technical experts to a supplier's facility to help make operations more efficient. Cost and technical data reporting requirements imposed by commercial organizations on their suppliers were extensive in many cases (GAO, 1970).

More recently, Ellram (2002) conducted detailed case studies of strategic cost management in five large manufacturing firms. Should-cost analysis was one of the cost tools used. She found that should-cost analysis is used for purchases of all types and is used "to facilitate improvement both within the organization and with suppliers, to increase the organization's understanding of costs, as a tool to work more closely with suppliers, and to help support evaluation of other cost analysis approaches, external data, bids, and other items" (p. 14).

Other research describes how companies use should-costing to determine what they should pay their suppliers for products. Smock, Rudzky, and Rogers (2007) describe the use of should-costing for this purpose by forward-thinking companies in general.

Caterpillar uses should-costing to estimate what purchased parts ought to cost and how design changes might affect the cost (Manufacturing Business Technology, 2006).

Bailey et al. (2011) describe their development of a should-cost model for full-truckload freight shipments, used by American Airlines to assess bid quotes from full-truckload carriers.

Should-cost modeling is used in the natural gas drilling industry to better understand prices bid for supplier services and for use in negotiations with the suppliers (Newton, Cody, and Carr, 2010).

² Single-sourcing is buying from one supplier when others are available. Sole-sourcing is when only one supplier for a particular item is available.

Monczka, Trent, and Handfield (2001) write that important features of cost-based pricing are the financial incentives offered to the supplier for performance better than that agreed to as part of the purchasing agreement (p. 444) and the mutual sharing of the cost savings (p. 445). Thus, better performance and mutual financial benefits are purposes in conducting these analyses.

Commercial manufacturers including Toyota, Whirlpool, and LG Electronics use the similar technique of target costing (Teague, 2009).

Ellram (2000) sampled 11 companies from eight industries and addressed, among other issues, the issue of why organizations use target costing. She found that the reasons include cost reduction, cost disclosure and understanding, continuous improvement/competitiveness, improved communications and early involvement, and improved design and accountability (p. 42).

Key Takeaways from Commercial Experience with Should-Cost and Similar Analysis

The relationship between DoD and the few large prime contractors from which it buys major weapon systems is unusual, and possibly even unique. When we try to learn lessons about buying practices from commercial organizations and apply them to DoD, we must keep these differences in mind. Despite the differences, our review of commercial practices offers provocative insights into the appropriate nature of the buying relationship between DoD and its suppliers, the purposes for which the analyses can be used, and how to organize and staff to use should-cost and similar analyses effectively.

The Appropriate Nature of the Buying Relationship Between DoD and Its Suppliers

A central tenet of DoD acquisition reform in the 1990s was the belief that DoD's requirements for detailed cost data imposed an unusual and unnecessary burden on defense contractors and that removing the requirements and moving to a price-based acquisition approach would save time and money. A review of DoD acquisition outcomes found no evidence of meaningful savings (Lorell, Graser, and Cook, 2005). The review of commercial practices in this chapter reveals that DoD's requirements for detailed cost data are not so unusual. Commercial organizations use cost analysis methods with their suppliers appropriate to the nature of their relationship with the supplier. Detailed information on cost and process is shared in commercial industry when relationships with suppliers are strategic alliances. For weapon systems that are made by contractors specifically for DoD and to its specifications, it seems appropriate to consider these relationships strategic alliances.

The Purposes for Which Should-Cost and Similar Analyses Can Be Used

The sharing of detailed data and expertise between supplier and purchaser during should-cost and similar analyses serves at least three important purposes in commercial organizations. Similar benefits could accrue in DoD.

First, the purpose of should-cost and similar analyses is to allow buying organizations to determine how much they should pay for products when negotiating with suppliers.

Second, the sharing of detailed data and expertise between supplier and purchaser during should-cost and similar analyses helps improve processes and practices, which results in cost

savings for both parties. The participants benefit by becoming more competitive in the marketplace, and ideally more profitable.

A third important purpose of should-cost and similar analyses is to gain a better understanding of the costs to develop and produce products and of the relationship between product attributes and costs. This understanding is especially useful during the development of new products, when commercial firms using the target costing approach seek to develop a product that will be affordable to the customer.

The same intention of target costing in commercial organizations was sought by DoD through CAIV and remains the intention of DoD in the “affordability as a requirement” policy for product development (Carter, 2011). Successful implementation of this intention requires credible shared costs, willingness to trade between cost and capability, and the commitment to not violate the target cost. The Joint Strike Fighter (JSF) program is probably the most conspicuous current example of the difficulty in implementing such an approach in DoD. The program used a CAIV approach prior to system development and demonstration and developed goals for the procurement cost of the aircraft. In the Selected Acquisition Reports prepared by DoD and sent to Congress, DoD described the program through 2009:

The cornerstone of the JSF Program is affordability—reducing the development cost, production cost, and cost of ownership of the JSF family of aircraft. The program was structured from the beginning to be a model of acquisition reform, with an emphasis on jointness, technology maturation and concept demonstrations, and early cost and performance trades integral to the weapon system requirements definition process. (U.S. Department of Defense, 2009)

However, the government had to rely heavily on industry for the tools that informed trades between cost and capability on the JSF, leading to overly optimistic estimates of the capability that could be achieved at the target cost. Once the program entered system development and demonstration, the CAIV approach was abandoned, although important design decisions continued to be made (Blickstein et al., 2011). Even as estimated costs for the product rose to over 50 percent higher than the original estimates and threatened the program’s affordability, DoD proved reluctant to scale back its requirements.

Despite DoD’s difficulty in using processes such as CAIV and related methods to acquire affordable weapon systems, the intention and similar methods such as target costing and should-cost are encompassed by OSD’s will-cost/should-cost initiative.

The final section of the chapter, below, summarizes what can be learned from commercial experience about organizing and staffing to use should-cost and related methods to control costs.

How to Organize and Staff to Use Should-Cost and Similar Analyses Effectively

The studies of commercial practices reviewed here show that, similar to the use of should-cost in the Air Force, cross-disciplinary review teams are most effective, with participation of people with cost or finance skills, and leadership typically from the purchasing (contracting) organization or shared with another organization. Success factors are similar to those found in Air Force use of should-cost analysis and include skilled personnel, management support, and adequate cost databases and information systems. The effectiveness of should-cost analysis compared with other strategies appears to be affected by the degree of competition among

suppliers, with other strategies such as competitive bidding or re-sourcing more effective when competition permits.

The most useful and highly rated measure of purchasing effectiveness, from the perspective of corporate leaders, was the savings resulting from negotiations.

The next chapter draws on the experience reviewed in previous chapters with should-cost and similar reviews in the Air Force and in commercial organizations to explore how the Air Force could enhance its capability to conduct such reviews.

How Can the Air Force Enhance Its Capability to Conduct Should-Cost Reviews?

This chapter on should-cost reviews draws lessons learned about how, why, and by whom should-cost reviews were conducted for the purpose of enhancing future Air Force capability to conduct such reviews. The discussion assumes that DCMA will continue to have lead responsibility for the overhead portion of should-cost reviews.

The lessons drawn in this section are derived from interviews with cost analysts, engineers, and price analysts who participated in program and overhead should-cost reviews, and from literature reviews.

Existing Should-Cost Review Capabilities

As a baseline from which to consider recommendations for enhancements to existing capabilities, it is helpful to understand the nature of those capabilities. The Air Force has no dedicated organic should-cost capability, although it does have individuals with the required skills in key areas, including cost estimating, pricing, contracting, and industrial engineering, scattered throughout the enterprise. There are limited numbers of people in some or even most of these areas, and fewer still with experience with should-cost. Selected other organizations within DoD have dedicated, if limited, should-cost capabilities. The Air Force can make use of the services of these other organizations, and these capabilities should be considered when deciding what enhancements the Air Force should make to enhance its existing capabilities. For example, the team that conducted the EELV review in 2010 was composed of individuals with diverse skills from the Air Force, the Navy, NASA, the National Reconnaissance Office, DCMA, and various support contractors. This does not prove, however, that people with *all* the desired skills and experience were available, or that the Air Force would be able to conduct multiple reviews simultaneously of a similar scale.

DoD's foremost dedicated capability to conduct program should-cost reviews resides with the Navy's Price Fighters organization. The Navy Price Fighters' work on Air Force programs was described in Chapter Three. It is helpful to understand some salient features of that organization. Representatives from the Price Fighters mentioned several characteristics of their organization as strengths:¹

- Most of the people have hands-on technical expertise with the technology they are analyzing.

¹ Interview with Navy Price Fighters staff member, 2009 (name withheld by request).

- They are separate from any buying organization and thus have objectivity.
- They are dedicated to doing should-cost reviews and therefore have a great deal of experience and expertise with them.
- They are familiar with the handful of major defense prime contractors and their accounting systems and business practices.
- They understand and are able to relate to program management, contract and pricing, and technical personnel.

Management of the organization devotes a lot of attention to selecting the right personnel. Roughly half of the people in the organization are industrial engineering technicians, industry specialists, or business industry specialists. These people have industrial experience in their background—five to 15 years of hands-on experience as a machinist or mechanic, electrician, tool and die maker, or in other trades. They come from military depots or shipyards, as well as from private industry. Another roughly one-quarter of the staff are engineers. All staff receive classroom training in cost analysis. There is extensive on-the-job training with more experienced staff.²

Air Force customers valued the Navy Price Fighters' technical or subject-matter expertise with the work being done by the contractors, cost modeling ability, and willingness and ability to assist contracting officers in "going toe-to-toe" with contractors during negotiations.³

Within DoD, overhead should-cost review capability resides primarily within DCMA. DCMA forms teams to conduct reviews, at major contractor locations, of contractor indirect costs, elements of their business base, rates, and other areas of special interest.⁴ Since its creation in 1990, the number of personnel at DCMA (then called Defense Contract Management Command) has decreased by roughly 60 percent. DCMA is currently rebuilding its contract pricing and cost monitoring capabilities. The accounting systems of major defense contractors are extremely complex, so DCMA personnel need strong accounting and auditing skills to be effective in overhead reviews. The capability to conduct overhead should-cost reviews was not assessed as part of this research.

Key Workforce Capabilities Required for Should-Cost Reviews

The key participants on a program should-cost review depend to some extent on whether the program is in development or production. Key members on reviews of development and production programs in the past two decades are cost estimators, engineers with expertise in the technical disciplines involved, and contracting personnel to arrange for the appropriate contracting vehicle to achieve cost savings. Manufacturing personnel are especially useful in production programs, as are test personnel in development programs. In some cases it may be beneficial to include a program manager with skills in business strategies to incentivize the

² Interview with Navy Price Fighters staff members, 2010 (names withheld by request).

³ Interview with Air Logistics Center, Contracting Directorate, staff member, 2009 (name withheld by request).

⁴ The Air Force used to have this capability in its Air Force Contract Management Division until the organization was disestablished in 1990 and its contract management functions were transferred to the newly created Defense Contract Management Command within DLA. Defense Contract Management Command has since been renamed Defense Contract Management Agency and made separate from DLA.

contractor.⁵ Similarly, pricers should be key participants if the reviews are to be used as the basis for contract negotiations.

Fitzgerald maintains that industrial engineers are needed to estimate labor based on standard work hours. The Air Force's now-obsolete *Should Cost* pamphlet, AFP 70-5, advised the same approach. However, Fitzgerald argues that the entire discipline has been deemphasized, that industrial engineering practices are declining in the aerospace industry, and that the increasing prices for aircraft over time are a result.⁶

The Air Force has organic personnel with the individual skills needed to participate in should-cost reviews, but questions remain regarding whether there are enough people in key disciplines, whether they have knowledge or background in the programs being reviewed, and whether they are available to work on reviews that interrupt their regular duties and probably require significant travel. The numbers of Air Force personnel in some of the disciplines are small. For example, there were only 164 pricers in the Air Force at the end of FY 2009 and only 160 industrial engineers, with 135 of the latter at just three locations—Tinker, Robins, and Wright-Patterson Air Force bases (Air Force Personnel Center, 2012).

More generically, the Air Force has several thousand engineers of various types, but the numbers alone do not indicate how many have subject-matter expertise in programs that may be candidates for should-cost reviews. Nor do the numbers indicate experience with reviews of this nature or the ability or willingness to participate in them.

The only thing that is clear from examining Air Force and commercial experience is that a cross-functional team of various skills is needed to conduct should-cost reviews. Given the mixed record of success with achieving savings, and the changes in the nature of acquisition programs (particularly the trend to outsourcing), it is not clear what mix of personnel would be most effective in current acquisition programs. Recommendations in Chapter Six address this question.

Total Number of People Required to Conduct Should-Cost Reviews

The total number of people required to establish a dedicated capability for should-cost review is determined by the size of should-cost teams and the demand for large should-cost reviews. The size of individual teams involved in the reviews discussed in this report varied, from roughly a dozen on some reviews to 80 to 100 on the B-2 review in the 1980s and over 100 on the EELV review. The B-2 team included those doing overhead reviews at three major contractor locations. Program should-cost review teams on more recent and typical reviews, such as for the Joint Primary Aircraft Training System and Global Hawk, have been much smaller.

The increasingly dispersed nature of production of major weapon systems also affects the size of individual teams. For aircraft systems, the engines and avionics systems have for a long time been manufactured by suppliers to prime contractors. Airframe fabrication and assembly, as well as most integration, used to be performed largely at a single prime contractor site. The production process for many airframe components was more consolidated; prime contractors would fabricate airframe parts in one location on a factory floor, wire and assemble in an adjacent location, and complete final assembly nearby. The current production processes are gener-

⁵ Interview with retired Air Force engineer, 2009 (name withheld by request).

⁶ Interview with A. Ernest Fitzgerald, retired Air Force Financial Management and Comptroller staff member, 2009.

ally far more outsourced. Fabricated parts from a third- or fourth-tier supplier may be sent to a second-tier supplier for wiring and assembly. These parts are then assembled at the prime site.

The diversification of industry supply chains across different enterprises and locations likely increases the expense, time, difficulty, and number of people needed to conduct thorough should-cost reviews. The direct production labor at the prime contractor represents a small fraction of the cost of most programs, which implies that it should not be the focus of analytic effort during the review. The trend to outsourcing changes the focus of the review to the upstream supply chain and how the prime contractor manages it rather than the prime contractor's in-house manufacturing. This shift may require different skills for participants as well. Programs including the C-17, F-22, and F-35 embody high levels of outsourcing. It would be useful to examine the experience of the review teams on these programs to determine the level of effort and skill mix required due to outsourcing.

Demand for reviews will depend on the number of large acquisition programs. By the FAR definition, demand would depend more strictly on the number of large acquisition programs entering production. The guidance from USD(AT&L) dramatically expands the demand for reviews, mandating that they be done for ACAT I, II, and III programs. The November 3, 2010 guidance directs that "Should cost' targets will be developed using sound estimating techniques that are based on bottom up assessments of what programs should cost, if reasonable efficiency and productivity enhancing efforts are undertaken. These costs will be used as a basis for contract negotiations . . ." (Carter, 2010b).

Organization for a Should-Cost Review Capability

Various organizational structures could be used to support a should-cost review capability within the Air Force.

The first approach is the current ad hoc arrangement, in which there is no dedicated capability and ad hoc teams are formed at the direction of high-level officials, such as the Assistant Secretary of the Air Force for Acquisition.

A second, somewhat more structured capability would be a skeletal or "virtual" organization, which would notionally include a capability to enable the rapid staffing and training of ad hoc should-cost teams and capture lessons learned.

A third, more robust possible organizational structure would consist of a small cadre of personnel who could lead should-cost teams. These leaders would conduct training, lead the should-cost teams, brief results, and document lessons learned. They would be augmented by specialists in required fields from other organizations.

A fourth organizational option would be a dedicated capability akin to the Navy Price Fighters organization, with permanent organic staff supplemented by support contractor staff and federally funded research and development centers as needed.

Each of these organizational structures has merits and demerits. The current arrangement, with no dedicated should-cost capability, is the least expensive, and one might argue that it avoids unnecessary duplication of an existing dedicated capability within the Navy that is available to the Air Force.

On the other hand, the lack of a dedicated organization has serious drawbacks. Because should-cost reviews are done infrequently, there are few people in the Air Force who have done them, and because they are staffed on an ad hoc basis, the few experienced people are scattered across the enterprise. The lack of a dedicated organization results in a loss of institutional knowledge, with no place to retain records or people with experience. This arrangement

ensures that the wheel is reinvented with each review, as inexperienced people grapple with how to perform a new task. Furthermore, depending on the level of the tasking and involvement by the official directing the study, it can be difficult to find and compel the participation of people with necessary skills.

A skeletal or virtual organization could alleviate many of these disadvantages. Notionally, a virtual organization would consist of a capability to enable the rapid staffing and training of ad hoc should-cost teams. This would include a contracting capability to be able to hire retirees, support contractors, federally funded research and development centers, or another government organization, such as the Navy Price Fighters, if organic Air Force support were not available. The virtual organization would exist at a high enough level, such as the Office of the Assistant Secretary of the Air Force for Acquisition, to have enough rank to direct the participation of organizations throughout the Air Force. The organization would be responsible for developing a training curriculum on should-cost reviews and arranging for ad hoc teams to be trained when formed. DAU or another provider could develop a suitable curriculum. Results and lessons learned from each review would be documented.

Compared with the current arrangement, a virtual organization would incur modest additional costs. It would facilitate the creation of teams with the required skills by broadening the potential pool of participants and providing a ready mechanism to employ them, and it would enhance their ability to conduct reviews by documenting and retaining lessons from previous reviews and providing training to new teams.

The third option for a small but more robust capability would provide the advantages of the skeletal organization enumerated above, with the added continuity and expertise of a small permanent cadre. The additional advantage would come at the added expense of additional staff.

These three options have the advantage of adding minimal cost and personnel authorizations compared with a fully staffed and dedicated capability. However, the less robust options have potential drawbacks. Staffing with retirees or support contractors would not build up an organic core of expertise, and the skills of retirees may not be current. In addition, to the extent that there are not enough existing organic personnel in key disciplines, these options do not increase the supply of scarce organic personnel.

A fourth option would be the creation of a dedicated capability to conduct should-cost reviews. It would be the costliest option. The specialized skills required and necessity for frequent travel imply the need for a relatively high average General Schedule (GS) grade level to attract the appropriate type of experienced personnel to conduct the should-cost reviews. This option would be appropriate only if the Air Force made a long-term commitment to using should-cost reviews as a contract negotiating practice. If the criteria for considering a review were as stated in the FAR (e.g., large, sole-source programs with some initial production and a history of increasing costs), ensuring a predictable and stable workload could be problematic. If reviews are conducted for all ACAT I, II, and III programs in accordance with current guidance, the issue of a steady workload becomes much less of a problem.

A dedicated staff would have important advantages. It would dedicate otherwise scarce skilled personnel to conducting should-cost reviews, so that availability of suitable personnel would not be a problem or at least less of a problem than it is currently. A dedicated staff would allow the development of institutional knowledge and experience in this specialized skill.

A potential disadvantage is that a dedicated staff performing only should-cost reviews may lose touch with the most current manufacturing and engineering processes. Another potential

drawback is that technical staff would be less likely to be subject-matter experts on programs being reviewed than technical staff drawn from a program office or related organization. Also, in a time of decreasing budgets, a dedicated staff would likely require taking funding and billets from other functions.

Another important consideration regarding a should-cost capability is its location within the Air Force. Commercial best practices indicate that such functions are usually led by cost/financial management or contracting personnel and that top-level support in the organization is needed for success. The need for high-level organizational support for success indicates that a location in either the office of the Assistant Secretary of the Air Force for Financial Management or the Assistant Secretary of the Air Force for Acquisition would be appropriate.

Table 5.1 summarizes the organizational options presented.

Table 5.1
Advantages and Disadvantages of Organizational Options for an Air Force
Should-Cost Capability

Organizational Option	Advantages	Disadvantages
Ad hoc	Least costly	Least capable Loss of institutional knowledge
Skeletal or virtual	Inexpensive Develops training Captures lessons learned Allows quick hiring	No permanent substantive staff to build expertise
Cadre	Same as skeletal, plus Builds core leadership	More personnel billets and cost Staff burnout
Dedicated capability	Same as cadre, plus Staff availability and experience	Costliest Staff could lose touch

Recommendations and Conclusions

This study examined the capability to conduct should-cost reviews in the Air Force. Several key findings emerged:

- Should-cost reviews are a special form of cost analysis described by the FAR, and according to the FAR are to be used as a tool in contract negotiations
- Although should-cost reviews can identify inefficiencies and potential ways to reduce costs, this does not automatically translate to savings. The Air Force must be willing and able to use the results of the analyses to negotiate lower prices on contracts and must structure and administer the contracts so that the final prices do not increase and negate the originally negotiated prices.
- The FAR specifies that program should-cost reviews should be considered in certain circumstances, especially for sole-source production of major acquisitions.
- There is a lack of evidence that should-cost reviews save money compared with other forms of contract pricing and negotiation, as well as a lack of evidence about key factors or circumstances that determine the success of reviews.
- The nature of production processes has changed since the heyday of should-cost reviews in DoD in the 1970s. Today most of the manufacturing of weapon systems is not done by prime contractors but is outsourced, and most of the dollar value of weapon systems is provided by suppliers. Typically, little of the dollar value of a weapon system is attributable to direct labor at the prime contractor. These changes imply a different focus and different techniques for should-cost reviews from those used in the past.
- The Air Force finds people to conduct should-cost reviews from among its own personnel, Air Force retirees, other government agencies, support contractors, and federally funded research and development centers.
- The Air Force does not have a dedicated capability to conduct should-cost reviews, which hampers the retention of institutionalized knowledge, experience, and lessons learned.
- Few Air Force personnel have experience with should-cost reviews, and little if any training in how to do them has been provided to participants in recent reviews. Enhanced capability to do should-cost reviews requires training for all participants.

Recommendations

Four recommendations are offered to enhance the Air Force's capability to conduct should-cost reviews:

1. Determine whether should-cost reviews in the Air Force result in savings compared with other forms of contract negotiation, and whether there are factors, such as methodology, team composition, or external circumstances, that affect success.
2. Assess lessons learned from recent should-cost reviews.
3. Develop training on should-cost reviews, including training to facilitate interdisciplinary exchange on multidisciplinary teams.
4. Establish databases of cost, schedule, earned value, and technical information useful for cost estimating and pricing activities.

Determine Whether Should-Cost Reviews in the Air Force Result in Savings Compared with Other Forms of Contract Negotiation

Price negotiations resulting in savings were the single most valued and used measure of purchasing effectiveness by CPOs and CEOs in commercial organizations (Fearon and Bales, 1997). We believe it is a useful metric for the Air Force, too, and therefore our first recommendation is to gather and analyze the information to compare different forms of cost analysis for contract negotiation.

The RAND research team found little evidence that indicates that any of the various methods of contract pricing and negotiation in the Air Force achieved better results than the others. Two studies, the more recent from 1983, did formal comparisons of matched pairs of Air Force contracts (same product and contractor, one contract negotiated with should-cost and one without) and found no significant difference in the results. Both studies suffered from very small sample sizes that limit confidence in the results. A GAO study from 1973 found greater reductions in negotiated prices when should-cost was used, but the contract prices were not final at time of the study and therefore did not necessarily represent savings. Opinions expressed in interviews about the savings achieved by should-costs were not based on formal structured comparisons, and the opinions were mixed.

Some participants and observers consider the C-17 review conducted in 1994 to be most successful of those in recent memory. The circumstances surrounding this review were unusual in that the Air Force had identified credible alternatives to buying additional C-17s, so that all participants understood that the future of the program was at stake. Conversely, interviewees describing reviews that did not achieve significant savings often cited circumstances in which the Air Force had no good alternatives. These interviews at least suggest a hypothesis that should be explored in a more formal comparison of outcomes of different pricing and negotiation techniques.

An important first step, then, in formulating a strategy for the use of should-cost reviews would be to determine whether they result in savings compared with other forms of contract negotiation, under what circumstances, and using what methodologies. It might be the case that should-cost reviews are successful when the industrial engineering approach is used, when a contracting officer leads the team, when a viable alternative exists to the program under review, or under other circumstances or using other processes. Results should shape workforce size, skill mix, and methodological approaches. Comparisons of already completed contracts

would be most helpful in the near term. Completed contracts would capture the final contract price after any changes that may have occurred during execution.

Assess Lessons Learned from Recent Should-Cost Reviews

In 2010, the Air Force conducted should-cost reviews of the EELV and Global Hawk programs, and, in 2011, DoD conducted a should-cost review of the F-35 program, reflecting a resurgence of high-level interest within DoD in using should-cost reviews to reduce costs. Because of the uneven history of should-cost reviews on large programs, the lack of a dedicated capability within the Air Force to conduct such reviews, and the shortage of people within the Air Force in conducting such reviews, we recommend that an assessment of lessons learned from these and any other recent efforts be conducted. The assessment should address how changes in the manufacturing of modern weapon systems affect the focus and techniques used in should-cost reviews, whether people with the required skills were available and what additional skills would be needed for similar reviews in the future, whether sufficient time was available for the reviews, the role of training in the capability to conduct the reviews, and the outcome of the reviews.

Part of the assessment might include learning lessons from organizations recognized as embodying best practices in this area, including commercial organizations, and benchmarking Air Force experience against their methodologies, organizational structure, and staffing.

On the EELV and Global Hawk reviews, each team captured lessons learned. This is a positive step. The Air Force should ensure that lessons learned from reviews are captured in a consistent fashion and documented, retained, and made available for training future teams.

Develop Training on Should-Cost Reviews

This recommendation is contingent on the outcome of the previous recommendation, and on the content of the should-cost training module that is in development at DAU as of late FY 2011. If the assessment of lessons learned finds that the recently conducted should-cost reviews had positive outcomes, and that there is a need for skill development to be able to conduct reviews in the future, the Air Force should invest in a training curriculum, developed by DAU or another training provider. The curriculum should be shaped by findings from the lessons-learned assessment but might include such topics as how to select should-cost team members, how to share information and interact on a multidisciplinary team, and how to translate information from the should-cost estimate into a lower negotiated contract price. Because should-cost reviews have not been done frequently in the Air Force in the recent past, most participants have little, if any, experience with the process. A training curriculum could help establish a repeatable process regardless of which individuals were involved. In developing the training, the training provider should consider training practices in commercial organizations that use should-cost successfully.

Contributions from multiple disciplines are needed to accomplish should-cost reviews. In particular, a solid technical assessment of a program and the labor needed to perform it is the foundation of this work. In interviews with those involved in the acquisition process, a frequent concern was the quality of technical inputs from subject-matter experts. Another frequent concern was the lack of understanding of the motivations or of the contributions of others in the process. For example, cost estimators and pricers often need the same data but ask for them in different ways, in different formats, or over different time periods (such as calendar year versus fiscal year). These interdisciplinary frictions have the potential to degrade the

quality of the analyses. For example, subject-matter experts may not be able to convey their knowledge in a helpful way to those doing cost/price analysis, or cost/price analysts may not be able to convey what information they need and why.

One way to address this problem is with training between members of different functional groups who work together. To enhance technical assessments, cost estimators and pricers could be trained to explain to subject-matter experts how the technical input will be used. Subject-matter experts could be trained in how to provide assessments that are useful for cost and price analysis. Other members of the acquisition workforce might be trained in understanding the needs and contributions of their colleagues from different functional areas.

Establish Databases of Cost, Schedule, Earned Value, and Technical Information Useful for Cost Estimating and Pricing Activities

An industry best practice recommended for adoption by the Air Force is the creation and maintenance of a corporate-level knowledge database that can be used for contract negotiations. The industry best practice is to assign people the responsibility to maintain it and for that duty to part of their job description and performance appraisal.

In the Air Force, relevant data, such as those on cost, schedule, earned value, and technical issues, are collected by members of various disciplines or organizations but are often not shared. For example, schedule and earned value data are collected by individual program managers but not routinely shared with cost-estimating organizations that could use the data to build databases and develop better cost-estimating relationships. Analysts attempting to assess how much labor effort will be required to perform a task on a contract are unaware of similar tasks and labor incurred on similar previous contracts. This stovepiping of information handicaps Air Force acquisition efforts and makes each acquisition decision less informed than it could have been if acquisition data were shared across the enterprise.

A positive example of establishing and sharing a cost-related database is the Air Force Total Ownership Cost database (AFTOC). AFTOC contains operating and support costs for Air Force systems and infrastructure. As an additional resource to cost estimators, AFTOC also contains aircraft weight statements and operational test reports for aircraft. These documents provide technical and operational characteristics from other disciplines that are often used by cost estimators.

Another positive example of an enterprise-wide database is the Defense Cost and Resource Center (DCARC), which is part of the OSD Office of Cost Assessment and Program Evaluation. The DCARC contains contractor cost data reports and earned value reports on large acquisition programs, which are available to the DoD cost analysis community. The contractor cost data reports on large programs are available going back several decades. The earned value reports are available only over the past few years.

While the cost and schedule data on large programs collected by the DCARC are an invaluable resource, the Air Force would benefit from a similar supplementary database on smaller Air Force programs, or major components of programs, that would ideally include data on aircraft trainers and simulators, support equipment, sustainment contracts, etc.

The exact nature of the database and the data should be informed by results of the above recommendations. The Air Force should first determine whether its should-cost reviews are effective, using what methodologies and data, and under what conditions. Commercial practices, data sources, and training should be assessed. Based on these findings, the investment in the appropriate database can be made.

Conclusions

Should-cost analysis as described in the FAR is a specialized form of cost analysis, used to support contract negotiations, that is characterized by a focus on the elimination of contractor inefficiencies. It is significant that the guidance for should-cost analysis is found in the federal regulation for the contracting function, because contracting is the process by which the government specifies what it wants to buy and at what price.

It is a difficult task to identify inefficiencies and potential savings. Doing so requires the cooperation of the prime contractor and subcontractors as well as technical expertise that is scarce among government personnel. But the potential savings will only be achieved if the government and contractor agree to eliminate the identified inefficiencies and are successful in negotiating a contract that binds the contractor to a lower price. The negotiation task is also difficult and requires a skilled contracting officer who can use the results of the should-cost review to inform negotiations. The negotiation task is made more difficult because the government is frequently in the position of wanting a product that is available from only one supplier and thus is negotiating from a disadvantageous position.

The tasks of identifying potential savings and negotiating contracts that achieve the potential savings require technical skills that can be learned and improved by Air Force acquisition personnel, if given the right tools. But it will take more than technical skills to achieve significant savings in Air Force programs. The experience assessed here suggests that should-cost reviews are more successful when supported by high-level leadership throughout DoD and when the government has credible alternatives to the program in question that strengthen its bargaining position. These additional factors for success may present a greater challenge than conducting a should-cost analysis.

References

AFP 70-5—See Headquarters U.S. Air Force, *Should Cost*, AFP 70-5.

Air Force Personnel Center, “Interactive Demographic Analysis System,” 2012. As of January 17, 2012: http://access.afpc.af.mil/vbinDMZ/broker.exe?_program=IDEAS PUB.IDEAS_default.sas&_service=pZ1pub1&_debug=0

Bailey, Michael J., John Snapp, Subramani Yetur, Jeffrey S. Stonebraker, and Steven A. Edwards, “Practice Summaries: American Airlines Uses Should-Cost Modeling to Assess the Uncertainty of Bids for Its Full-Truckload Shipment Routes,” *Interfaces*, Vol. 41, No. 2, March–April 2011, pp. 194–196.

Blickstein, Irv, Michael Boito, Jeffrey A. Drezner, J. A. Dryden, Kenneth P. Horn, James G. Kallimani, Martin C. Libicki, Megan McKernan, Roger C. Molander, Charles Nemfakos, Chad Ohlandt, Caroline Reilly, Rena Rudavsky, Evan Saltzman, Jerry M. Sollinger, Katharine Watkins Webb, and Carolyn Wong, *Root Cause Analyses of Nunn-McCurdy Breaches, Volume 1: Zumwalt-Class Destroyer, Joint Strike Fighter, Longbow Apache, and Wideband Global Satellite*, Santa Monica, Calif.: RAND Corporation, MG-1171/1-OSD, 2011. As of January 17, 2012: <http://www.rand.org/pubs/monographs/MG1171z1.html>

Bolten, Joseph G., Robert S. Leonard, Mark V. Arena, Obaid Younossi, and Jerry M. Sollinger, *Sources of Weapon System Cost Growth: Analysis of 35 Major Defense Acquisition Programs*, Santa Monica, Calif.: RAND Corporation, MG-670-AF, 2008. As of January 17, 2012: <http://www.rand.org/pubs/monographs/MG670.html>

CAPS Research, *2005 Supply Management Performance Benchmarking Report*, Institute for Supply Management and Arizona State University, November 3, 2005.

Carter, Ashton B., “Better Buying Power: Guidance for Obtaining Greater Efficiency and Productivity in Defense Spending,” memorandum for acquisition professionals, Washington, D.C., Office of the Under Secretary of Defense (Acquisition, Technology, and Logistics), 2010a.

———, “Implementation Directive for Better Buying Power—Obtaining Greater Efficiency and Productivity in Defense Spending,” memorandum for Secretaries of the Military Departments and Directors of the Defense Agencies, Washington, D.C., Office of the Under Secretary of Defense (Acquisition, Technology, and Logistics), 2010b.

———, “Should-Cost and Affordability,” memorandum for defense acquisition and logistics professionals, Washington, D.C., Office of the Under Secretary of Defense (Acquisition, Technology, and Logistics), 2011.

Carter, Ashton B., and Robert F. Hale, “Joint Memorandum on Savings Related to ‘Should Cost,’” memorandum for Secretaries of the Military Departments; Chairman of the Joint Chiefs of Staff; Commanders of the Combatant Commands; Director, Administration and Management; Directors of the Defense Agencies; and Directors of the DoD Field Activities, Washington, D.C.: Office of the Secretary of Defense, 2011.

Conway, 1st Lt David V., and 1st Lt Michael J. Howenstine, *Statistical Evaluation of the Effect of Should Cost on Contract Negotiations for Air Force and Army Weapons Systems*, Wright-Patterson Air Force Base, Ohio: Air Force Institute of Technology, 1983.

Defense Procurement and Acquisition Policy, *Defense Federal Acquisition Regulation Supplement (DFARS) and Procedures, Guidance, and Information (PGI)*, Subpart 215.4: Contract Pricing, 2011.

Ellram, Lisa M., "A Structured Method for Applying Purchasing Cost Management Tools," *International Journal of Purchasing and Materials Management*, Vol. 32, No. 1, February 1996, p. 11.

———, *The Role of Supply Management in Target Costing*, Tempe, Ariz.: Center for Advanced Purchasing Studies, 1999.

———, "Purchasing and Supply Management's Participation in the Target Costing Process," *Journal of Supply Chain Management*, Vol. 36, No. 2, March 2000, pp. 39–51.

———, *Strategic Cost Management in the Supply Chain: A Purchasing and Supply Management Perspective*, Tempe, Ariz.: Center for Advanced Purchasing Studies, 2002.

Fearon, Harold E., and William A. Bales, *Measures of Purchasing Effectiveness*, Tempe, Ariz.: Center for Advanced Purchasing Studies, 1997.

FAR—See U.S. General Services Administration, U.S. Department of Defense, and National Aeronautics and Space Administration, *Federal Acquisition Regulation*.

Fitzgerald, A. Ernest, *The High Priests of Waste*, 1st ed., New York: Norton, 1972.

GAO—See U.S. General Accounting Office.

Headquarters U.S. Air Force, *Should Cost*, AFP 70-5, Washington, D.C., 1989.

Heitman Jr., Capt Lee R., and Capt Teddy J. King, *Critical Success Factors for Should Cost Planning*, Wright-Patterson Air Force Base, Ohio: Air Force Institute of Technology, 1984.

Honda Supply Team, "How to Become a Supplier," 2011. As of January 17, 2012:
http://www.hondasupplyteam.com/j_pstat/html/honda_howto_supplier.htm

Lorell, Mark A., John C. Graser, and Cynthia R. Cook, *Price-Based Acquisition: Issues and Challenges for Defense Department Procurement of Weapon Systems*, Santa Monica, Calif.: RAND Corporation, MG-337-AF, 2005. As of January 17, 2012:
<http://www.rand.org/pubs/monographs/MG337.html>

Manufacturing Business Technology, "'Should-Cost' Metric Leads to Parts, Materials Savings," *Manufacturing Business Technology*, Vol. 24, No. 8, August 7, 2006, p. 37.

Monczka, Robert M., Robert Trent, and Robert B. Handfield, *Purchasing and Supply Chain Management*, 2nd ed., Florence, Ky.: Cengage South-Western, 2001.

Morin, Jamie M., and David M. Van Buren, *Implementation of Will-Cost and Should-Cost Management*, Washington, D.C.: Department of the Air Force, 2011.

Newton, Chris, Preston Cody, and Rick Carr, *Sourcing Critical Oilfield Services for Shale Plays in a Tightening Supply Market*, Deloitte Center for Energy Solutions, 2010.

Office of the Deputy Director of Defense for Procurement and Acquisition Policy for Cost, Pricing, and Finance, "Introduction to Contract Pricing," in *Contract Pricing Reference Guides, Volume 1: Price Analysis*, no date.

Sanders, Peter, and Daniel Michaels, "Pratt Revs Up Jet-Engine War—GE and Rolls-Royce Jockey to Beat Resurgent Rival as Boeing and Airbus Pursue Their Own Dogfight," *Wall Street Journal*, June 22, 2011.

Schaefer, Lt Col William E., and Maj Roy F. Birkhead, *An Appraisal of the Short-Term Cost Results of a Selected Number of Air Force Should Cost Studies*, Wright-Patterson Air Force Base, Ohio: Air Force Institute of Technology, 1975.

Smock, Douglas A., Robert A. Rudzki, and Stephen C. Rogers, "Should Cost," *CSCMP's Supply Chain Quarterly*, October 3, 2007, pp. 68–75.

Teague, Paul, "Target Costing Leads to Profits," *Purchasing*, Vol. 138, No. 10, 2009.

Ulrich, Keith A., *Should Cost: Guidelines for the Selection of Team Members*, Fort Lee, Va.: U.S. Army Procurement Research Office, Institute of Logistics Research, U.S. Army Logistics Management Center, 1973.

U.S. Army Materiel Command Headquarters, *Procurement: Should-Cost Analysis Guide*, Washington, D.C., 1972.

- U.S. Department of Defense, *Selected Acquisition Report (SAR): F-35*, Washington, D.C., 2009.
- U.S. General Accounting Office, *Feasibility of Using "Should Cost" Concepts in Government Procurement and Auditing*, Washington, D.C., B-159896, May 20, 1970.
- , *Application of "Should Cost" Concepts in Reviews of Contractors' Operations*, Washington, D.C., B-159896, February 26, 1971.
- , *Assessment of Air Force Should-Cost Studies*, Washington, D.C., B-159896, July 31, 1973.
- U.S. General Services Administration, U.S. Department of Defense, and National Aeronautics and Space Administration, *Federal Acquisition Regulation*, Volumes I and II, March 2005. As of January 18, 2012: <https://www.acquisition.gov/far/>
- Weida, Maj Ralph E., and Maj George M. Sloan, *The Feasibility of Establishing "Should Cost" as a Permanent AFCMD/AFPRO Function*, Wright-Patterson Air Force Base, Ohio: Air Force Institute of Technology, 1972.
- Williams, Robert Leon, *A Review of the "Should Cost" Process and Management Issues of the Process*, Monterey, Calif.: Naval Postgraduate School, 1985.
- Womack, James P., Daniel T. Jones, and Daniel Roos, *The Machine That Changed the World*, New York: First HarperPerennial, 1991.